TIDAL HARBOURS COMMISSION.

APPENDIX (C.)

TO

SECOND REPORT

OF

THE COMMISSIONERS,

WITH

SUPPLEMENT

AND

INDEX.

Presented to both Houses of Parliament by Command of Her Majesty.

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CONTENTS.

Page

SUMMARY REPORT on the Harbours of Scotland, by Captain WASHINGTON, R.N., Examining Commissioner . . . . xvii, lxiii

APPENDIX (C.)—containing the Evidence taken at each Port, with the Reports of Engineers and others . . . . 1—613

SUPPLEMENT . . . . 615—672

INDEX . . . . 673—712

LIST OF PLATES.

Sheet. To face Page.

1. Plans of Leith, Fisherrow, Cockenzie, North Berwick, Dunbar, Eyemouth, and Berwick 136
2. Plans of Granton, Grangemouth, Stirling, Alloa, Charleston, Inverkeithing, Burntisland, Kirkcaldy, Leven, Elie, Crail, &c. 164
3. Plans of St Andrews, River Tay, Perth, Dundee, Arbroath, Montrose, Johnshaven, Gourdon, Bervie, and Stonehaven 268
4. Plans of Aberdeen, Boddam, Peterhead, Fraserburgh, Macduff, Banff, Lossiemouth, Burghead, and Nairn 346
5. Plans of Inverness, Cromarty, Little Ferry, Brora, Helmsdale, Lybster, Wick, Thurso, and Scrabster 376
6. Plans of Stornoway, Oban, Inverary, Ardrishaig, River Clyde, Glasgow, Dumbarton, Port Glasgow, Greenock, Gourock, Lamlash, Saltcoats, and Port William 518
7. Plans of Rothesay, Largs, Ardrossan, Irvine, Troon, Ayr, Campbelltown, Loch Ryan, Portpatrick, Kirkcudbright, Dumfries, and Annan 612
8. Sections of the Piers at Berwick, Dunbar, Kirkcaldy, Arbroath, Stonehaven, Aberdeen, Peterhead, Fraserburgh, Banff, Sarclet, Wick, Troon, Ardrossan, and Portpatrick . 625

CONTENTS OF APPENDIX (C.)

LEITH.

Page
1. Evidence taken before the Tidal Harbours Commission on the 5th October, 1846 . . 1
2. Return to Order of the House of Commons of 9th August, 1844 4
3. Mr. Whitworth, on enlarging the Harbour, with Estimates, 1786 5
4. Mr. Shirreff, on enlarging and improving the Harbour and Town, 1787 9
5. Mr. Rennie, on the state of the Harbour, and the projected Docks and Estimates, 1799 . 21
6. Mr. Rennie's Second Report on Leith Harbour and projected Docks, 1800 . . . 30
7. Mr. W. Chapman, on the improvement of the Harbour and Estimate, 1824 . . . 33
8. Mr. R. Stevenson's Statement, relative to Leith Harbour, 1824 36
9. Report of the Committee of Inhabitants on the improvement of the Harbour, 1827 . . 38
Mr. Rennie's Report on Mr. Chapman's Plan for the Harbour, 1827—[*See Supplement.*]
10. Mr. Telford's Report on improving Leith Harbour, 1828 40
11. Mr. Cubitt, on the projected New Harbour and Docks, 1834 42
12. Mr. Anderson, C.E., on making the Wet Docks available, by a deep-water entrance at Newhaven, with Estimates, 1834 48
13. Messrs. Dickson, on the best mode of improving the Harbour, with Estimates, 1835 . 53
Messrs. Grainger and Miller, on a Harbour and Wet Docks at Trinity, 1835—[*See Supplement.*]
14. Mr. Milne, on extending the Harbour to the East, and Estimate, 1838 54
15. Mr. Cubitt's Second Report on Leith Harbour and Docks, 1839 64
16. Mr. Walker's Report on the Harbour and Docks, 1839 66
17. Mr. Milne's Second Report on extending the Harbour to the East, and Estimate, 1839 . 69
18. Mr. Napier's proposal for the improvement of Leith West Wet Dock, 1844 . . . 73
19. Petition of the Edinburgh and Dundee Steam Packet Company, 1845 74
20. Mr. Mitchell, on the arrangement of the Harbours, 1847 75
21. Mr. Rendel, on the improvement of Leith Harbour and Docks, 1847 77
22. Instructions from the Hydrographer of the Admiralty, relative to a Time-ball at Leith, 1846 . 81
23. Captains Washington and Vetch, on the want of a Time-ball, for the shipping at Leith, 1846 81
24. Return of Income and Expenditure, 1841-2-3 83

FISHERROW.

25. Return to Order of House of Commons of 9th August, 1844 84
26. Messrs. Stevenson's Report on improving the Harbour, 1839 84
27. Return of Income and Expenditure for the years 1842-3-4 84

MORRISON'S HAVEN.

28. Return to Address of the House of Commons of 29th July, 1844 85

COCKENZIE.

29. Return to Order of the House of Commons of 9th August, 1844 85
30. Return to Address of the House of Commons of 29th July, 1844 85

NORTH BERWICK.

31. Return to Order of the House of Commons of 9th August, 1844 86
32. Letter from Chief Magistrate, relative to Reports and Plans of the Harbour, 1845 . . 86
33. Return of Income and Expenditure for the years 1842-3-4 86

DUNBAR.

34. Evidence taken before the Tidal Harbours Commission on the 7th October, 1846 . . 87
Income and Expenditure for the years 1841-46 87
35. Return to Order of the House of Commons of the 9th August, 1844 90
36. Mr. Smeaton's Report on the Harbour, 1772 91
37. Mr. Mitchell's Report on the new Harbour, 1841 92
38. Letter from the Secretary of the Admiralty to the Provost of Dunbar, 1842 . . . 93
39. Mr. Walker, C.E., on the Sufficiency of the Works at Dunbar, 1843 93
40. Extract from the Acts of the General Convention of Royal Burghs of Scotland, held at Edinburgh, 1844 94
41. Petition of the Royal Burghs of Scotland, in General Convention assembled, to the Lords of the Treasury, 1844 94
42. Memorial of the Harbour Committee of the Burgh of Dunbar to the Tidal Harbours Commission, 1845 95
43. List of Wrecks in the vicinity of Dunbar, 1816-47 96
Capt. Vetch, R. E., on forming a Harbour of Refuge at Dunbar—[*See Supplement,—Miscellaneous.*]

EYEMOUTH.

44. Evidence taken before the Tidal Harbours Commission on the 13th April, 1847 . . 100
45. Return to Order of the House of Commons of the 9th August, 1844 102
46. Mr. Smeaton, on improving the Harbour, 1767 102
47. Statement of Shipmasters, &c., relative to Eyemouth, 1836 103
48. Mr. Jardine's Report on the Harbour, 1837 103
49. Admiral Sir David Milne's Memorandum on Eyemouth Harbour, 1837 103
50. Mr. Mitchell, on proposed Improvements in the Harbour, 1840 104

CONTENTS OF APPENDIX (C.)—*continued.*

EYEMOUTH—*continued.*

Page
51. Mr. J. S. Robertson's Report to the Directors of the National Floating Breakwater and Refuge Harbour Company, and reply thereto, 1842 106
52. Memorial of the Merchants, Shipowners, &c., interested in having a Harbour of Refuge on the East Coast of Great Britain 107
53. Petition of Shipping Companies, Merchants, and Shipowners belonging to Leith, Dundee, Musselburgh, &c., to the Lords Commissioners of the Admiralty 108
54. Petition of the Merchants, Corn-dealers, Fish-curers, and Fishermen in Leith and Newhaven, to the Lords of the Admiralty 109
55. Account of the Number of Boats belonging to Eyemouth, the Number of Fishermen and others employed in the Curing of Herrings, and Cod and Ling Fisheries, in the year ending 5th April, 1841 111
56. Statement of the capabilities of the Harbour, 1842 112
57. Return of Income and Expenditure for the years 1841–2–3 114
Number of Boats, Fishermen, &c., employed in the District, 1846—[*See Supplement.*]
Abstract of Income and Expenditure, 1837–46—[*See Supplement.*]

BERWICK-ON-TWEED.

58. Evidence taken before the Tidal Harbours Commission on the 7th October, 1846 . . 115
Mr Chisholm's Letter respecting the want of shelter at the Ballast Quay, 1846. . . 116
Notes relative to the Building of Berwick Pier, and date of its Erection 118
59. Return to Order of the House of Commons of 9th August, 1844 118
60. Mr. Rennie, on the Harbour and erecting a Pier on the Beacon Rock, and Estimate, 1807 . 119
61. Mr. Rhodes, on the best means of improving the River and Harbour, 1835 . . . 120
62. Mr. Rhodes's Second Report, on the state of the Works, 1836 121
63. Mr. Cubitt, on the state of the Harbour and of proposed Breakwater, and Estimate, 1837 . 123
64. Mr. Rhodes's Third Report, on Constructing a Floating Dock, and Estimate, 1838 . . 125
65. Mr. Rhodes's Fourth Report, on the Harbour and Works, 1838 125
66. Mr. Rhodes's Fifth Report, on the Works of the Harbour, 1838 126
67. Case and Opinion, on the Liability of Harbour Commissioners to lay Accounts before Town Council, 1844 127
68. Shipowners' Memorial to the Harbour Commissioners on the want of a Breakwater, and proceedings of the Harbour Board thereon, 1845 129
69. Mr. C. Moor, on the inefficiency of the Breakwater prayed for in Shipowners' Memorial, 1845 130
70. Correspondence, on the want of Quay accommodation on the South side of the Tweed, 1846. 131
71. Letter from Mr. Robert Guthrie to the Tidal Harbours Commission on the Proceedings of the Harbour Board, 1846 132
72. Mr. A. Robertson, on the management of the Harbour, 1846 136
73. Return of Income and Expenditure for the years 1842–6 138

GRANTON.

Messrs. Stevenson, on forming a Harbour at Granton, 1834—[*See Supplement.*]
74. Mr. Walker, on the site for a new Pier at Granton, 1835 138
75. Abstract of Exports and Imports at Granton Pier for the years 1843–4–5–6 . . . 143

BORROWSTOWNESS.

76. Return to Order of the House of Commons of 9th August, 1844 144
77. Return of Income and Expenditure for the years 1842–3–4 144

GRANGEMOUTH.

78. Return of Income and Expenditure for the years 1841–2–3, and authority to levy Dues . 144
79. Return of Income and Expenditure of Pollok's Wharf for the years 1841–2–3, and authority to levy Dues 144

STIRLING.

80. Return to Order of the House of Commons of 9th August, 1844 145
81. Mr. R. Stevenson, C.E., on the best means for improving the Harbour and Firth, 1828 . 145
82. Memorial of the Forth Navigation Commissioners to the Lords of the Treasury, 1845 . . 148
83. Substance of Messrs. Galbraith's and Stevenson's Evidence, taken before the Tidal Harbours Commission on the 6th June, 1845 149
84. Return to Address of the House of Commons of 29th July, 1844 149

ALLOA.

85. Return to Order of the House of Commons of 9th August, 1844 150
86. Messrs. Stevenson and Bald, on the Formation of a Wet Dock, and Estimate, 1826 . 151
87. Return of Income and Expenditure for the years 1842–3–4 153

KINCARDINE.

88. Return to Order of the House of Commons of 9th of August, 1844 153
89. Return to Address of the House of Commons of 29th July, 1844 153

INVERKEITHING AND ST. DAVID'S.

90. Correspondence respecting Return to Address of the House of Commons of 29th July, 1844, 153

ABERDOUR.

91. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 154

BURNTISLAND.

92. Return to Order of the House of Commons of 9th August, 1844 154
93. Return of Income and Expenditure for the years 1841–2–3 155

CONTENTS OF APPENDIX (C.)—*continued.*

PETTYCUR.

Page

94. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 155

KIRKCALDY.

95. Return to Order of the House of Commons of 9th August, 1844 155
96. Mr. Leslie's Report on the Improvement of the Harbour, and the Formation of Docks, 1839, 156
97. Return of Income and Expenditure for the years 1842–3–4 158

DYSART.

98. Return to Order of the House of Commons of 9th August, 1844 158
99. Mr. J. Leslie's Report on the works necessary for the Security and Improvement of the Harbour, 1838 159
100. Return of Income and Expenditure for the years 1842–3–4 159

METHILL.

101. Return of Income and Expenditure for the years 1841–2–3 160

LEVEN.

102. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 160

ELIE.

103. Messrs. Stevenson and Son. on forming a Harbour of Refuge at Elie, and Estimate, 1836 . 160
104. The Master Mariners of St. Monance, on the efficiency of Elie as a Harbour of Refuge, 1838 162

PITTENWEEM.

105. Return to Order of the House of Commons of 9th August, 1844 163
106. Return of Income and Expenditure for the years 1842–3–4 163

ANSTRUTHER.

107. Return to Order of the House of Commons of 9th August, 1844 163
108. Return of Income and Expenditure for the years 1841–2–3 164

KILKENNY OR CELLARDYKE.

Mr. Leslie, C. E., on a projected Fishing Harbour at Craignoon—[*See Supplement,—Miscellaneous.*]

CRAIL.

109. Return to Order of the House of Commons of 9th August, 1844 164
110. Mr. J. Leslie, C.E., on forming an Asylum Harbour in Rome Bay, to the eastward of Crail, 1846 164
111. Return of Income and Expenditure for the years 1842–3–4 165

ST. ANDREWS.

112. Return to Order of the House of Commons of 9th August, 1844 165
113. Memorial of the Provost, Magistrates, and Town Council, to the Commissioners of Highland Roads and Bridges, 1816 166
114. Notes and Extracts of Minutes of Proceedings of Town Council, relative to the Harbour, 1559–1845 166
115. Return of Income and Expenditure for the years 1842–3–4 170

FERRY-PORT-ON-CRAIG.

116. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 170
117. Admiralty Report on the Tay Ferry, 1847 170

WOODHAVEN.

118. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 171

NEWPORT.

119. Return to Address of the House of Commons of 29th July, 1844 171

BALMERINO.

120. Return of Income and Expenditure for the years 1841–2–3, and authority to levy Dues . 172

WEST NEWBURGH AND NEWBURGH.

121. Return of Income and Expenditure for the years 1841–2–3 172

PERTH.

122. Evidence taken before the Tidal Harbours Commission on the 1st October, 1846 . . 173
123. Return to Order of the House of Commons of 9th of August, 1844 175
124. Dr. Adam Anderson, on the Discharge of the Tay, 1831 176
125. Messrs. Stevenson and Son, on Improving the Navigation between Perth and Newburgh, and making a Tide Harbour and Wet Dock at Perth, and Estimate, 1834 176
126. Memorial of the Lord Provost and Town Council, and Harbour Commissioners of Perth, to the Lords of the Admiralty, 1844 179
127. Messrs. Stevenson's Report on the Tay, and proposed Railway Bridge over the River near Mugdrum, 1845 182
128. Mr. Rendel's Report on a Bridge over the Tay at Mugdrum, 1845 190
129. Memorial of the Harbour and Tay Navigation Commissioners to the Tidal Harbours Commission, 1845 192

CONTENTS OF APPENDIX (C.)—*continued.*

PERTH—*continued.*

Page
130. Statement of sums received and expended under the Perth Navigation and Harbour Acts, from 1830 to 12th September, 1846 193
131. Return of Income and Expenditure for the years 1842–3–4 193

DUNDEE.

132. Evidence taken before the Tidal Harbours Commission on the 2nd October, 1846 . . 194
133. Return to Order of the House of Commons of 9th August, 1844 201
134. Mr. Smeaton, C.E., on the State of the Harbour, 1770 202
135. Mr. R. Stevenson, C.E., on the Improvement of the Harbour, 1814 203
136. Mr. Telford, C.E., on the Works at Dundee Harbour 207
137. Mr. Jardine, C.E., on the Extension of the Docks and Estimate, 1830 209
138. Mr. Gibb, on the Proposed Works in Dundee Harbour, 1831 210
139. Mr. Gibb's Second Report on the Harbour of Dundee, 1832 211
140. Mr. J. Leslie, C.E., on the proposed Jetty at Broughty Ferry, 1835 213
141. Mr. J. Leslie, on the progress of Improvements in Dundee Harbour, 1838 . . . 213
142. Reports by Mr. J. Leslie, on the Operations in the Bed of the Tay, at Powgavie, and statement for Counsel's opinion, 1813 219
143. Mr. J. Leslie, on a Dyke and Cairn below South Ferry, 1844 222
144. Mr. Wm. Blackadder, C.E., on the effects upon the Scour at Dundee, by the operations in the Tideway at Powgavie, 1844 222
145. Case and Opinion as to the limits of the jurisdiction of the Harbour Trustees, 1844 . . 224
146. Captain Washington, R.N., on the Tay Navigation, 1844 226
147. Complaint of the want of a Low-water Pier at Dundee, and Mr. Leslie's Report thereon, 1844 and 1845 228
148. Mr. Walker, C.E., on Embanking the Shore or Bed of the Tay, 1845 229
149. Mr. J. Leslie, on a Low-water Pier at Dundee, 1845 234
150. Mr. Jardine's Report in the Case of the Dundee Harbour Trustees against Mr. David Hunter, of Broughty Ferry, 1845 236
151. Mr. Robert Stevenson, on the proposed Floating Light at the entrance of the Tay, 1845 . 236
152. Statement of Complaints by the Inhabitants of Broughty Ferry, relative to the heavy Shore Dues exacted by the Dundee Harbour Trustees, and the want of Proper Landings, 1846 . 237
153. Mr. Sturrock, on the want of Defences for the Protection of the Shipping in the Tay, 1846 . 237
154. Complaints by Mr. P. Greig, on the high charges for Harbour and Light Dues on the River Tay, 1846 238
155. Complaints by the Edinburgh and Dundee Steam-Packet Company of the excessive Charge of Harbour and Light Dues at Dundee, 1846 239
156. Mr. Allardice, on the want of a Low-water Pier at Dundee, 1847 239
157. Decision of the Lord Ordinary in the case of Lindsay v. Harbour Trustees, and Mr. Lindsay's Petition to the House of Commons, 1846–7 241
158. Return of Pilotage, and Tay-light dues levied on Shipping during the years 1843–44 . 242
159. Return of Income and Expenditure for the years 1841–2, 1842–3, 1843–4 . . . 242
160. List of Wrecks at the entrance of the River Tay, 1825–45 243

ARBROATH.

161. Evidence taken before the Tidal Harbours Commission on the 30th September, 1846 . . 244
162. Return to Order of the House of Commons of the 9th August, 1844 245
163. Memorial of the Magistrates and Town Council, Harbour Commissioners and Shipowners to the Lords of the Treasury, 1844 245
164. Memorial of the Harbour Trustees to the Tidal Harbours Commissioners, 1845 . . 247
165. Mr. J. Leslie's Estimate for Deepening the Harbour, 1845 249
166. Second Memorial of the Harbour Trustees to the Tidal Harbours Commissioners, 1845 . 249
167. Letter from Mr. Wm. Leask, Master of the barque "Hants," to the Harbour Trustees, 1845, 250
168. Statement of Shipwrecks in the vicinity of Arbroath, 1796 to 1845 250
169. Statement of Shore Dues from 1727 to 1845 251
170. Comparative Statement of Revenue for the years 1845 and 1846 252
171. Return of Income and Expenditure for the years 1841–2–3 252

MONTROSE.

172. Evidence taken before the Tidal Harbours Commission, on the 29th September, 1846 . . 253
173. Return to Order of the House of Commons of 9th of August, 1844 255
174. Mr. Walker, C.E., on the proposed Wet Docks at Montrose, 1839 255
175. Messrs. Leslie and Blackadder's Answers to Mr. Rendel's Queries, relative to the Basin and Harbour Channel, and Sir James Carnegie's Embanked Ground, 1842 256
176. Mr. Rendel's Report on the enclosure of Tidal Mudlands, by Sir James Carnegie, 1845 . 257
177. Correspondence relative to the Embankments in the South Esk River, 1842–5 . . . 258
178. Return of Income and Expenditure for the years 1841–2–3 260

JOHNSHAVEN.

179. Return of Income and Expenditure for the years 1841–2–3, and authority to levy Dues . 260

GOURDON.

180. Return of Income and Expenditure for the years 1841–2–3, and authority to levy Dues . 260

STONEHAVEN.

181. Return to Order of the House of Commons of 9th August, 1844 261
182. Mr. Robert Stevenson, C.E., on the best means of improving the Harbour, with Estimate, 1812 261
183. Statement of the capabilities of the Harbour for the purpose of obtaining Funds, by Subscription, for its Improvement, 1824 266

CONTENTS OF APPENDIX (C.)—*continued.*

STONEHAVEN—*continued.*

Page
184. Mr. Robert Stevenson's Second Report on the Harbour, and its Improvements, 1830 . 266
185. Memorial of Harbour Trustees to the Tidal Harbours Commissioners, 1846 . . . 267
186. Return of Income and Expenditure for the years 1841–2–3 268

ABERDEEN.

187. Evidence taken before the Tidal Harbours Commission on the 26th October, 1846 . . 269
188. Return to the Order of the House of Commons of 9th August, 1844 272
189. Mr. Smeaton, C.E., on improving the Harbour, 1770 273
190. Mr. Rennie, C.E., on the best means of improving the Harbour, and Estimates, 1797 . 275
191. Mr. Telford's Report on the Improvement of the Harbour, and Estimates, 1802 . . 279
192. Messrs. Telford and Jessop, on improving the Harbour, 1805 280
193. Mr. Walker, C.E., on the Harbour and proposed Docks of Aberdeen, 1838 . . . 281
194. Mr. Walker, on Messrs. Hogarth, Pirie, and Read's plan for improving the Harbour, 1838 . 284
195. Mr. Abernethy, C.E., on the advantage of constructing Wet Docks, and Estimates, 1842 . 286
196. Messrs. Abernethy and Gibbs's Report on proposed Wet Docks, and Estimate, 1842 . 289
197. Mr. A. Gibb, on the best mode of improving the Harbour, 1842 290
198. Mr. Wm. Leslie, on turning the course of the River Dee, 1842 293
199. Report of the Sub-Committee of Inhabitants on the State of the Harbour, 1842 . . 294
200. Receipt of Customs Dues for the years 1805–46 297
201. Return of Income and Expenditure for the years, 1841–2–3 298

BODDAM.

202. Extracts of a Letter from Rod. Gray, Esq., respecting the Harbour of Boddam, 1846. . 299

PETERHEAD.

203. Evidence taken before the Tidal Harbours Commission on the 26th September, 1846 . . 300
204. Return to Order of the House of Commons of 9th August, 1844 302
205. Letter from Mr. Smeaton, relative to the Harbour of Peterhead, 1772 303
206. Mr. Rennie, C.E., on enlarging and improving the Harbour, and Estimate, 1806 . . 304
207. Report by the Harbour Trustees on the State of the Harbour, 1812 307
208. Petition of the Governors of the Maiden Hospital to the Commissioners of Highland Roads and Bridges, 1815 308
209. Memorial from Peterhead to the Commissioners of Highland Roads and Bridges, on Damage occasioned by Storm, 1820 309
210. Mr. R. Stevenson's Report on the Harbour, 1824 311
211. Mr. R. Stevenson's Report on the North Harbour of Peterhead, 1826 311
212. Mr. R. Stevenson, on the best means of improving the Harbour, with Estimates, 1826 . 312
213. Memorial of the Harbour Trustees, on the proposed Improvement and Extension of the Harbour of Peterhead, and their fitness for Harbours of Refuge, 1844 314
214. Mr. D. Stevenson, C.E., on the Improvement of the Harbour, with Estimate, and Notes of Evidence, 1847 317
215. List of Wrecks in the vicinity of Peterhead, 1816–46 322
216. Statement of Wind-bound Vessels and Tonnage, 1834–45 324
217. Return of Income and Expenditure for the years 1841–2–3 324

FRASERBURGH.

218. Return to Order of the House of Commons of 9th August, 1844 325
219. Mr. Stevenson, on the Harbour, and a new South Pier, 1818 325
220. Mr. J. Gibb, on the best means of improving the Harbour, and Estimate of Extension of Pier, 1837 326
221. Mr. Walker, C.E., on the capabilities of the Harbour, and Estimate for New Works, 1840 327
222. Letter from Chief Magistrate to Lord Saltoun, on the capabilities of Fraserburgh as a Harbour of Refuge, with Extract of Mr. Stevenson's Report thereon, 1844 328
223. Fish-curers' Memorial to the Harbour Commissioners on the want of Accommodation for the Fishing Craft, 1845 329
224. Statement of period and Cost of Erection of the several Piers and Quays, and of Excavations in the Harbour, 1808–36 329
225. Memoranda by Mr. Lewis Chalmers, relative to building the Piers at Fraserburgh, 1847 . 330
226. Return of Income and Expenditure for the years 1841–2–3 , ... 330

PITTULIE.

227. Return of Income and Expenditure for the years 1841–2–3, and authority to levy Dues . 330

ROSEHEARTY.

228. Return of Income and Expenditure for the years 1841–2, 1842–3, 1843–4, and authority to levy Dues 330

GARDENSTONE.

229. Return of Income and Expenditure for the years 1841–2–3, and of authority to levy Dues . 331

MACDUFF.

230. Return of Income and Expenditure for the years 1841–2–3, and of authority to levy Dues . 331
231. Mr. Bremner's Memoranda, relative to the proposed New Harbour, 1846 . . . 331
232. Admiralty Report on proposed Improvements, 1847 331

BANFF.

233. Return to Order of the House of Commons of 9th August, 1844 332
234. Memorial of the Provost and Town Council to the Commissioners for Highland Roads and Bridges, on Damage occasioned by Storm, 1820 332

CONTENTS OF APPENDIX (C.)—*continued.*

BANFF—*continued.*

Page
Mr. T. Telford's Report on the damage done to the Works at Peterhead and Banff, and Estimates for Restoration and Additions, 1820 333
Treasury Letter to the Commissioners of Highland Roads and Bridges, 1820 . . 333
235. Mr. J. Bremner, on the best means of Repairing the Breakwater, 1837 333
236. Mr. J. Bremner, on the State of the Harbour, 1845 334
237. Mr. Abernethy, on the best means of improving the Harbour, and Estimate, 1845 . . 334
238. Return of Income and Expenditure for the years 1841–2–3 335

WHITEHILLS.

239. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 336

PORTSOY.

240. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 336

BLACKPOTS.

241. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 336

CULLEN.

242. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 336

PORT GORDON.

243. Return of Income and Expenditure for the years 1342–3–4, and authority to levy Dues . 336

GARMOUTH.

244. Return to Address of the House of Commons 29th of July, 1844 337

LOSSIEMOUTH.

245. Return to Order of the House of Commons of 9th of August, 1844 337
246. Letter from a Merchant, on the excessive Rate of Harbour Dues, 1846 337
247. Letter from Lloyd's Agent, on the proceedings of the Harbour Board, 1846 . . . 337
248. Return of Income and Expinditure for the years 1841–2, 1842–3, 1843–4 . . . 338

BURGHEAD.

249. Return to Order of the House of Commons of 9th August, 1844 338
250. Extract of a letter from the Town Council, on Harbour Dues, 1846 339
251. Return of Income and Expenditure for the years 1841–2–3 339

FINDHORN.

252. Return to Order of the House of Commons of 9th August, 1844 339
253. Return of Income and Expenditure for the years 1842–3–4 339

NAIRN.

254. Return to Address of the House of Commons of 29th July, 1844 340
255. Mr. J. Gibb, on the best means of improving the Harbour, and Estimate, 1816 . . 340
256. Mr. Telford, on improving the Harbour, 1816 342
257. Petition of the Provost, Magistrates, and Town Council to the Convention of the Royal Burghs of Scotland, on the want of means for repairing the Harbour, 1834 . . . 342
258. Mr. Mitchell, on the best means of remedying the damage done to the Harbour by the Land Floods, 1835 344
259. Messrs. Gibb and Mitchell, on the means of counteracting the injurious effects of Land . Floods, 1837 345
260. Messrs. Leslie and Mitchell, on constructing a Breakwater in Nairn Harbour, 1845 . . 345

INVERNESS.

261. Evidence taken before the Tidal Harbours Commission on the 23rd September, 1846 . . 347
262. Return to Order of the House of Commons of 9th August, 1844 351
263. Memorial and Statement of the Provost of Inverness, relative to the rights of the Burgh to Shore and Anchor Dues (referred to in No. 261) 352
264. Mr. W. Leslie, C.E., on the proposed Steam-boat Pier at Inverness, and Estimate, 1834 . 354
265. Opinion of Counsel as to the right of the authorities of the Burgh to levy Dues within the limits granted by Charter, 1846 355
266. Captain Maynard, R.N., and Mr. D. Stevenson, C.E., on the proposed Improvement at Inverness, 1847 355
267. Admiralty Report to Parliament, on the Harbour Plan, 1847 357
268. Return of Income and Expenditure for the years 1842–3–4 357

CROMARTY.

269. Return to Order of the House of Commons of 9th August, 1844 357
270. Return of Income and Expenditure for the years 1841–2–3 358

PORTMAHOLMACK.

271. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 358

LITTLE FERRY.

272. Return to Order of the House of Commons of 9th August, 1844 358
273. Return of Income and Expenditure for the years 1841–2–3 358

BRORA.

274. Return to Order of the House of Commons of 9th August, 1844 359
275. Mr. G. Gunn's remarks on Leck Roby, 1845 359

CONTENTS OF APPENDIX (C.)—*continued.*

HELMSDALE.

Page.
276. Return to Order of the House of Commons of 9th August, 1844 359
277. Mr. W. Leslie, on the Damage to the Harbour by Land Floods, the best means for remedying it, and improving the Harbour, and Estimate, 1839 359
278. Return of Income and Expenditure for the years 1841–2–3 361

LYBSTER.

279. Return to the Order of the House of Commons of 9th August, 1844 361
280. Additional Notes on the Harbour, by Mr. H. Sinclair, the Proprietor of the Harbour, 1846 . 362
281. Return to Address of the House of Commons on 29th July, 1844 362
Return of Income and Expenditure for the years 1841–2–3 362

WICK.

282. Evidence taken before the Tidal Harbours Commission on the 21st September, 1846 . . 363
Mr. Rhind's Statement respecting the Harbour, 1847 365
283. Return to Order of the House of Commons of 9th August, 1844 366
284. Extracts from Lieut. Medley's Official Correspondence respecting Harbours, Lights, Pilots, &c., 1840–6 367
285. Messrs. Stevenson, on Mr. Bremner's proposed plan for improving the Harbour, 1847 . 370
286. Mr. M'Pherson, Lloyd's Agent, on the State of the Harbour, 1846 371
287. Return of Income and Expenditure for the years 1841–2–3 371
288. List of Wrecks in Sinclair Bay, 1840–45 372

ACKERGILL.

289. Lieut. Medley, R.N., on the want of a Pier at Ackergill, 1846 373

KIRKWALL,—ORKNEY.

290. Return to Order of the House of Commons of 9th August, 1844 373
291. Return of Income and Expenditure for the years 1841–2–3 374

NORTH RONALDSHA.

Lloyd's Agent, on the neglected state of the Harbours in the Orkneys, 1846—[*See Supplement.*]

LERWICK.

292. Return of Dues levied on Shipping for the years 1843–4 374
293. Mr. R. S. Kilgour, Collector of Her Majesty's Customs, on the neglected State of the Harbour, 1846 374
Lloyd's Agent, on the State of the Harbour, 1846—[*See Supplement*]

STROMNESS.

Lloyd's Agent, on the want of a Harbour at Stromness, 1846—[*See Supplement.*]

CASTLEHILL.

294. Return to Address of the House of Commons of 29th July, 1844 374

THURSO.

295. Return to Order of the House of Commons of 9th August, 1844 375
296. Return of Income and Expenditure for the years 1841–2–3 375

SCRABSTER.

297. Messrs. Stevenson's Report on Scrabster Pier and Harbour, 1847 375

STORNOWAY.

298. Return to Order of the House of Commons of 9th August, 1844 376
299. Answers to Printed Queries, by Professor Lewis Gordon, 1847 377
300. Return of Income and Expenditure for the years 1842–3–4 377

ISLAY.

Lloyd's Agent, on throwing Ballast into the Harbour, 1846—[*See Supplement.*]

TOBERMORY.

301. Return of Income and Expenditure for the years 1841–2–3, and authority to levy Dues . 377
Lloyd's Agent, on the want of Extension of the Quay, 1846—[*See Supplement.*]

OBAN.

302. Return to Address of the House of Commons of 29th July, 1844 377

ARDRISHAIG AND CRINAN.

303. Return to Order of the House of Commons of 9th August, 1844 378
304. Return of Income and Expenditure for the years 1842–3–4 378

CAMPBELLTOWN.

305. Return to Order of the House of Commons of 9th August, 1844 379
306. Return of Income and Expenditure for the years 1842–3–4 379

TARBERT.

307. Return to Order of the House of Commons of 9th August, 1844 379
Mr. James Watt, on forming a Canal at Crinan and at Tarbert, 1772—[*See Supplement.*]

CONTENTS OF APPENDIX (C.)—*continued.*

TARBERT—*continued.*

Page.
Captain Sir E. Belcher, R.N., on the proposed Argyll Canal, 1847—[*See Supplement.*]
Lieut.-Col. P. Yule, R.E., on the proposed Argyll Canal, 1847—[*See Supplement.*]
308. Return of Income and Expenditure for the years 1841–2, 1842–3, 1843–4 . . . 380

KILMORY QUAY—LOCH-GILPHEAD.

309. Return to Address of the House of Commons of 29th July, 1844 . . . 380

INVERARY.

310. Return to Order of the House of Commons of 9th August, 1844 . . . 380
311. Return of Income and Expenditure for the years 1842–3–4 . . . 381

ROTHESAY.

312. Return to Order of the House of Commons of 9th August, 1844 . . . 381
313. Mr. R. Stevenson, on improving and enlarging the Harbour, and Estimate, 1815 . . . 381
314. Mr. R. Stevenson's Second Report on the Harbour, 1820 . . . 384
315. Return of Income and Expenditure for the years 1841–2–3 . . . 384

DUMBARTON.

316. Return of Income and Expenditure for the years 1841–2–3, and authority to levy Dues . . . 384

GLASGOW.

317. Evidence taken before the Tidal Harbours Commission on the 15th, 16th, and 21st of October, 1846 . . . 385
318. Return to Order of the House of Commons of 9th August, 1844 . . . 423
319. Mr. Smeaton, C.E., on the Deepening of the Clyde, 1755 . . . 424
320. Mr. Golborne, on the Deepening of the Clyde and Port Glasgow Harbour, and Estimates, 1768. 425
321. Mr. James Watt, on the state of the River, 1769 . . . 427
322. Mr. Golborne, on the Improvement of the River, 1781 . . . 428
323. Mr. Rennie, on Obstructions in the River Clyde, near the New Bridge, 1799 . . . 430
324. Mr. Telford's Report on forming a Dock at the Broomielaw, 1806 . . . 431
325. Mr. Rennie's Report and Plans of a Wet Dock in the Channel of the River, also of one in Windmillcroft, 1807 . . . 433
326. Mr. Rennie's Remarks on the proposed Docks, 1807 . . . 435
327. Mr. Rennie, on the Improvements in the Clyde, 1807 . . . 436
Mr. Rennie, on the Plan for a Dock in the River, 1807—[*See Supplement.*]
328. Mr. Rennie, on Improvements at the Broomielaw, 1809 . . . 441
329. Mr. Rennie's Specification for the proposed New Quay Wall at the Broomielaw, 1809 . . . 441
330. Mr. Telford's Report on a Wet Dock in the ground belonging to Dr. Reid, 1819 . . . 443
331. Mr. Telford, C.E., on extending the Broomielaw Quay, as the most advisable mode of getting additional Berthings and Wharfage, 1821 . . . 443
332. Letter from Mr. Reddie to Mr. Whidbey, with Queries as to deepening and improving the River, 1824 . . . 444
333. Mr. Whidbey, on the necessity of a free flow of the Tide up the River Clyde, 1824 . . . 444
334. Mr. Clark, on the Improvement of the Navigation of the Clyde, 1824 . . . 445
335. Mr. Telford, C.E., on the Broomielaw Harbour, 1826 . . . 446
336. Mr. Hartley, on the proposed extension of the South Quay Wall of the Broomielaw Harbour, and the construction of Docks, 1834 . . . 446
337. Statement of Sums paid to Engineers for Surveys, Reports, &c., for improving the River Clyde and Harbour of Glasgow, from 1752 to 1834 . . . 447
338. Mr. Logan, C.E., on the Improvements of the Clyde and Harbour of Glasgow, with Tables of Soundings and Borings, and Estimates, 1835 . . . 448
339. Mr. Walker's Report on the proposed Improvements of the River and Harbour, 1836 . . . 455
340. Mr. Russell's Report of Observations on the Tidal Wave of the River Clyde, the state of the Channel, and Improvement of the Navigation, and Table of Tides 1838 . . . 458
341. Mr. W. Bald's General Report on a part of the River Clyde, between Jamaica-street Bridge and the Glasgow Water-works, 1839 . . . 464
342. Comparative levels of the Tides in the Clyde, and widths of the River, 1840 . . . 466
343. Mr. W. Bald, C.E., on the proposed new Works for improving the Harbour of Glasgow and the Navigation of the River Clyde, and Estimates, 1844 . . . 468
344. Report by Messrs. Bald, Johnstone, and Russell, on laying down Rails on the Quays for Mineral Traffic, 1844 . . . 470
345. Extract from Clyde Police Record, of number of persons Drowned and recovered from the River Clyde, 1845-46 . . . 472
346. Report by Captain Bethune, R.N., and Captain Denison, R.E., on the state of the Clyde and Harbour of Glasgow, 1846 . . . 472
347. Report by a Committee of the Clyde Trustees, relative to the proposed Weir across the Clyde, 1846 . . . 475
348. Mr. A. M'Lellan, on the present and prospective state of the Harbour, as to Quay and Water room, 1846 . . . 477
349. Appendix to Mr. Bell's Evidence, 1846 . . . 477
350. Estimate for making a Harbour between Jamaica-street Bridge and Hutcheson's Bridge . . . 478
351. Estimate for making a Tidal Basin at Stobcross . . . 479
352. Arbiters' Award in the case of Clyde Trustees against Bridge Trustees, 1846 . . . 479
353. Account of the Custom Dues at Glasgow, from the year 1811 to 1846 . . . 480
354. Grounds purchased by the Clyde Trustees, and amounts of Purchase-money, 1831–46 . . . 481
355. Comparative Statement of Foreign Arrivals and Departures in 1828 and 1845, and Nine Months in 1845, with the corresponding Nine Months in 1846 . . . 481
356. Abstract of arrivals of Shipping at Glasgow, and the Number of Vessels drawing Six Feet of water and upwards, 1832–46 . . . 482

CONTENTS OF APPENDIX (C.)—*continued.*

GLASGOW—*continued.*

Page.
357. Statement of Revenue, Expenditure, and Debt of the River Clyde, from 1770 to 1846 . 484
358. Return of Revenue and Expenditure for the years 1841–2, 1842–3, 1843–4 . 485
359. Law and Jury Trial Expenses, &c., incurred by the Clyde Trustees, 1836–45 . 486

FORTH AND CLYDE CANAL.

360. Return of Revenue and Expenditure for the years 1841–2–3, and authority to levy Dues . 487

PORT DUNDAS.

361. Return of Revenue and Expenditure for the years 1841–2–3, and authority to levy Dues . 488

RENFREW.

362. Return to Order of the House of Commons of 9th August, 1844 . 488
363. Return of Income and Expenditure for the years 1842–3–4 . 488

PORT GLASGOW.

364. Return to Order of the House of Commons of 9th August, 1844 . 488
365. Mr. Walker, C.E., on the best means of obtaining additional Accommodation, 1830 . 489
366. Mr. Atherton, C.E., on the best means of constructing the proposed Docks, 1833 . 489
367. Mr. Logan, C.E., on deepening the Wet Dock, and affording better Accommodation to Shipping, 1837 . 490
The Provost of Port Glasgow, on the Constitution of the Harbour Trust, 1846—[*See Supplement.*]
368. Return of Income and Expenditure for the years 1841–2–3 . 491
369. Substance of Answers to Printed Queries, 1847 . 491

GREENOCK.

370. Evidence taken before the Tidal Harbours Commission on the 20th October, 1846 . 493
371. Return to Order of the House of Commons of 9th August, 1844 . 503
372. Mr. Rennie, C.E., on projected Wet Docks at Bay of Quick, 1802 . 503
373. Mr. Thom's Estimate of Docks proposed by Mr. Telford, 1835 . 506
374. Mr. Stewart offering Ground for Docks, 1835 . 507
375. Report of the Committee on the Harbours, 1835 . 507
376. Report by the Committee appointed to Inquire into the necessity of additional Harbour Accommodation, 1840 . 509
377. Mr. J. Locke, C.E., on the proposed Improvements of the Harbours, 1841 . 513
378. Memorial of Deep-sea Pilots to the Tidal Harbours Commission, 1846 . 515
379. Statement of Gross Revenue, with the Gross Debt, available means, and Net Debt applicable to the old Harbours, for the years 1824–46 . 516
380. Schedule of Bay Anchorage Dues . 516
381. Return of Income and Expenditure for the years 1841–2–3 . 517

GOUROCK.

382. Return to Order of the House of Commons of 9th August, 1844 . 517
383. Return of Income and Expenditure for the years 1842–3–4 . 517

LARGS.

384. Return to Order of the House of Commons of 9th August, 1844 . 518
385. Return of Income and Expenditure for the years 1841–2, 1842–3, 1843–4 . 518

MILLPORT.

386. Return to Order of the House of Commons of 9th of August, 1844 . 518
387. Return of Income and Expenditure for the years 1841–2–3 . 518

ARDROSSAN.

388. Return to Order of the House of Commons of 9th August, 1844 . 519
389. Statement relative to the Formation and Progress of the Harbour, 1838 . 519
    Report by Mr. Abercrombie and Captain Clark on the Harbour, 1812 . 521
    Opinion, by Captain Taylor, on the Harbour, 1812 . 522
    Description of the Harbour, by Mr. Henry, 1812 . 522
390. Mr. W. Jessop, on the Extension of the Pier, and Estimate, 1808 . 523
391. Statement relative to the Cost and Capabilities of the Harbour, 1810 . 524
392. Messrs. Rennie and Whidbey, on the State and Capabilities of the Harbour, 1811 . 524
393. Mr. Telford, on the best means of obtaining an Extensive and Commodious Harbour, 1812 . 525
394. Mr. Walker, on the Harbour, 1839 . 526
395. Extracts from Messrs. Grainger and Miller's Report on the Expense of forming Proposed Docks, 1839 . 529
396. Mr. J. Moffat, on the Capabilities of the Harbour after completion of Works in progress, 1844 529
397. Return of Income and Expenditure for the years 1842–3–4 . 533

SALTCOATS.

398. Return to Order of the House of Commons of 9th August, 1844 . 533
399. Specification for Proposed Improvement upon the outer end of Pier, 1841 . 534
400. Return of Income and Expenditure for the years 1841–2, 1842–3, 1843–4 . 535

IRVINE.

401. Return to Order of the House of Commons of 9th August, 1844 . 535
402. Mr. D. Smith, on the Enlarging and Improving the Harbour, 1826 . 536
403. Mr. J. Gibb, on the best means of Improving the Harbour, and Estimate, 1839 . 537
404. Return of Income and Expenditure for the years 1842–3–4 . 538

CONTENTS OF APPENDIX (C.)—*continued.*

TROON.

Page.

405. Return to Order of the House of Commons of 9th August, 1844 538
406. Substance of Answers to 120 Printed Queries relative to the Harbour, 1846 . . . 538
407. Return of Income and Expenditure for the years 1841–2–3 539

AYR.

408. Evidence taken before the Tidal Harbours Commission on the 23rd October, 1846 . . 540
409. Return by the Harbour Trustees of Acts, Maps, Plans, &c., 1845 545
410. Mr. Smeaton, C.E., on Improving the Harbour, 1772 545
411. Mr. Rennie, on extending the Piers of Ayr Harbour, and making a Wet Dock on the north side, 1805 547
412. Mr. Rennie's Second Report, on making a Wet Dock at Ayr, 1806 548
413. Mr. R. Stevenson, C.E., on the Improvement of the Harbour, 1830 549
414. Messrs. Stevenson and Sons, on the Harbour Lights, 1841 550
415. Protest by certain Harbour Trustees against exacting a Rate on Coal, 1842 551
416. Mr. J. Leslie, on the Choice of Site for Proposed Dock, 1846 552
417. Mr. Gordon's Statement, relative to the Harbour, 1846 552
418. Return of Income and Expenditure for the years 1842–3–4 554

GIRVAN.

419. Return of Authority to Levy Dues, 1846 554
420. Return of Income and Expenditure for the years 1842–3–4 554

BALLANTRAE AND DRUMORE.

421. Return to Order of the House of Commons of 9th August, 1844 555
422. Return of Income and Expenditure for the years 1841–2–3 555

LOCH RYAN.

423. Captain Beechey's Report on Loch Ryan, 1837 555

STRANRAER.

424. Return to Order of the House of Commons of 9th August, 1844 558
425. Return of Income and Expenditure for the years 1841–2–3 558

PORT PATRICK.

426. Evidence taken before the Tidal Harbours Commission on the 22nd October, 1846 . . 559
    Abstract of the whole Expenditure on the Works at Port Patrick, 1846 . . . 561
427. Return to Order of the House of Commons of 9th August, 1844 562
428. Mr. Smeaton, on the capabilities of the Harbour, 1770 562
429. Mr. Rennie, on the formation of the Harbour of Portpatrick 564
430. Selections from the Report of Captain Beechey, R.N., on the Packet Stations and communication between the South of Scotland and North of Ireland, 1837 569
431. Sir J. Rennie, on the Effects of the Gale of the 5th January, 1839, on the Works at Port Patrick, 1839 571
432. Letter from Sir John Rennie, on the eligibility of the Harbour as a Packet Station, 1842 . 572
433. Mr. Walker, C.E., on Repairing the Works of the Harbour and Proposed Improvements, with Estimate, 1843 576
434. Sir J. Rennie, C.E., on the fitness of Port Patrick as a Packet Station, 1843 . . . 578
435. Captain Evans, R.N., on Port Patrick Harbour, 1846 580
436. Sir J. Rennie's Observations on Captain Evans's Report, 1846 582
437. List of Wrecks in the vinicity of Portpatrick, 1828–45. 584
438. Return of Income and Expenditure for the years 1841–2–3, and authority to levy Dues . 584

PORT LOGAN, PORT NESSOCK BAY.

439. Return to Order of the House of Commons of 9th August, 1844 585
440. Mr. Rennie, C.E., on forming a small Harbour at M'Ferrand's Isles, and Estimate, 1813 . 585
441. Mr. J. Young, on forming a Breakwater in Port Nessock Bay, with Specification, and Estimate, 1820 587
442. Petitions to Parliament for converting Port Nessock Bay into a Harbour of Refuge, 1820 . 588
443. Mr. Linn, on the means of Improving the Harbour, 1840 591
444. Return of Income and Expenditure for the years 1841–2–3, and authority to levy Dues . 591

PORT WILLIAM.

445. Return to Order of the House of Commons of 9th August, 1844 592
446. Mr. Robertson Buchanan, C.E., on the State of the Harbour and Proposals for Improvement, 1812 592
447. Mr. John Linn's Specification on the mode of Constructing the Proposed Pier, and Estimates, 1841 593
448. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 594

.WHITHORN.

449. Return to Order of the House of Commons of 9th August, 1844 594
450. Return of Income and Expenditure for the years 1841–2–3 594

GARLIESTON.

451. Return to Order of the House of Commons of 9th August, 1844 595
452. Return of Income and Expenditure for the years 1841–2–3 595

BALDOON.

453. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 595

CONTENTS OF APPENDIX (C.)—*continued.*

BARLOCHAN.

Page.
454. Return to Address of the House of Commons of 29th July, 1844 596

CARTY.

455. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 596

WIGTOWN.

456. Return to Order of the House of Commons of 9th August, 1844 596
457. Return of Income and Expenditure for the years 1841–2, 1842–3, 1843–4 . . . 596

GATEHOUSE.

458. Return to Order of the House of Commons of 9th August, 1844. 597
459. Return of Income and Expenditure for the years 1841–2–3 597

KIRKCUDBRIGHT.

460. Return to Order of the House of Commons of 9th August, 1844 597
461. Return of Income and Expenditure for the years 1842–3–4, and authority to levy Dues . 597

DUMFRIES.

462. Return to Order of the House of Commons of 9th August, 1844 598
463. Mr. J. Hollinsworth, on the State and Proposed Improvements of the Harbour, 1810 . 598
464. Mr. Newall's Memoranda, on the Navigation and Improvement of the Nith, 1812 . . 599
465. Mr. Newall's Report on the State of the Nith, 1836–40 603
466. Answers to Printed Queries on the Harbour of Dumfries and the River Nith, 1846 . . 609
467. Mr. R. Maxwell Witham, on the Improvements of the River, 1847 612
468. Return of Income and Expenditure for the years 1841–2, 1842–3, 1843–4 . . . 613

ANNAN.

469. Return to Address of the House of Commons of 29th July, 1844 613
470. Substance of Answers to Queries, 1846 613

SUPPLEMENT.

LEITH.

471. Mr. Rennie's Report on Mr. Chapman's Plan for the Improvement of the Harbour, 1827 . 615
472. Messrs. Grainger and Miller, on the Formation of a Harbour and Wet Dock at Trinity, 1835 617

EYEMOUTH.

473. Number of Boats, Fishermen, and Fish-curers, &c., employed in the Eyemouth District, for the year ending 5th January, 1847 624
474. Abstract of Income and Expenditure for the years 1837–46 625

GRANTON.

475. Messrs. Stevenson, on forming a Harbour at Granton, 1834 625

NORTH RONALDSHA.

476. Mr. R. Scarch, Lloyd's Agent, on the Neglected State of the Harbours in the Orkneys, 1846 . 627

LERWICK.

477. Mr. A. Sutherland, Lloyd's Agent, on the State of the Harbour, 1846 628

STROMNESS.

478. Mr. J. M. Hamilton, Lloyd's Agent and Senior Magistrate, on the want of a Harbour at Stromness, 1846 628

ISLAY.

479. Mr. J. M'Lean, Lloyd's Agent, on throwing Ballast into the Harbour, 1846 . . . 628

TOBERMORY.

480. Mr. D. Campbell, Lloyd's Agent, on the want of Extension of the Quay, 1846 . . 628

TARBERT.

481. Mr. James Watt, on forming a Canal at Crinan and at Tarbert, 1772 629
482. Captain Sir E. Belcher, R.N., on the proposed Argyll Canal, uniting East and West Lochs, Tarbert, 1847 640
483. Lieut.-Col. P. Yule, R.E., on the proposed Argyll Canal, 1847 647

GLASGOW.

484. Mr. Rennie's Report, with Improvements on the Plan for a Dock in the River, also his Opinion of one in Mr. Reid's Ground, and Estimate, 1807 650

PORT GLASGOW.

485. The Provost of Port Glasgow, on the Constitution of the Harbour Trust, 1846 . . . 652

CONTENTS OF APPENDIX (C.)—*continued.*

MISCELLANEOUS.

Page.
486. Capt. Robinson, R.N., on the Buoying and Lighting of the Solway Firth, 1847 . . 652
487. Mr. Cunningham, Secretary to the Board of Northern Lights, on additional Lights and Buoys on the coasts of Scotland, 1847 652
488. Capt. Vetch, R.E., on forming a Harbour of Refuge at Dunbar, 1847 653
489. Account of Money Expended by the Commissioners of Highland Roads and Bridges on Scottish Harbours, 1807–24 653
490. Number and Tonnage of Vessels that paid Dues to the Board of Northern Lights, 1846 . 653
491. Table showing the Dues levied on Shipping and Goods, and the Debt due for 1844–5–6; the Gross Receipt of Customs Duty for 1845–6; and the Number and Tonnage of all Arrivals, and the Vessels Registered in 1846, at the Ports and Harbours of Scotland, and Berwick-upon-Tweed 654
492. Abstract of the Number and Tonnage of all Vessels Entered and Cleared at the several Ports and Creeks of Scotland for 1846 660
493. Number and Tonnage of Vessels taking shelter in the Harbours of Scotland, 1846 . . 661
494. Number of Boats and Men employed in the Herring and Cod and Ling Fisheries, at the several Fishing Creeks in Scotland, for the year ending 5th January, 1847 . . . 661
495. Income and Expenditure of the Clyde Trustees for the years 1844–5, 45–6, 46–7 . . 664
496. Continuation Statement of Revenue, Expenditure, and Debt, of the Clyde Trustees, 1770–1847 665
497. Mr. Leslie, C.E., on a projected Fishing Harbour at Craignoon, Cellardyke, 1838 . . 665
498. Estimate of deepening the River Clyde from Glasgow Bridge to Dumbuck Ford . . 667
499. Report on the River Cart, and the Harbour of Paisley 669
500. List of Printed Queries distributed to the several Ports and Harbours 671

LIST OF ALL THE PLACES AND SUBJECTS

REFERRED TO IN

THE REPORT, APPENDIX, SUPPLEMENT, AND INDEX.*

NOTE.—The Small Numerals refer to the page of the Report, the Roman Figures to the Appendix, Supplement, and Index.

	Report.	App.	Index.
ABERDEEN	xxxi	269	673
ABERDOUR	xxiv	154	674
ABERLADY BAY	xx		
ACHCASTLE	xxxix		
ACHELDEBUE	xliii	682	
ACHNECHARN	xliii		
ACKERGILL	xli	373	*ib.*
ALLOA	xxii	150	*ib.*
ANNAN	lix	613	*ib.*
ANSTRUTHER	xxv	163	675
ARBROATH	xxix	244	*ib.*
ARDNAMURCHAN	xliii	661	
ARDRISHAIG	xliv	378	676
ARDROSSAN	liv	519	*ib.*
ARD TRIDES	xlvi		
ARGYLL CANAL	xlvi	640	*ib.*
ARDLAMONT POINT	xlvii		
ARDNAMURCHAN	xliii	661	
ARRAN	xlvii		*ib.*
AUCHENCAIRN	lix		
AUCHMITHIE	xxxi		
AVOCH	xxxviii	661	*ib.*
AYR	lvi	540	*ib.*
BALCARY BAY	lix	612 633	
BALDOON	lviii	595	677
BALLANTRAE	lvi	555	*ib.*
BALLINTRAED	xxxviii	653	*ib.*
Ballast. (See also ALLOA and STROMNESS.)	xxii, lx, lxi		*ib.*
BALLINTORE	xxxviii		
BALMERINO	xxvii	172	*ib.*
BANFF	xxxiv	332	*ib.*
BARLOCHAN OF PALNACHIE		596	678
BARRA	xliii	661	
Beacons and Buoys. (See INVERNESS.)	xxxvii, lxi		*ib.*
BEACON ROCK	xxviii		
BEAULEY FIRTH	xxxvii		
BELL ROCK LIGHTHOUSE	xxx		
BERBECULA	xliii		
BERVIEDALE	xxxix		
BERWICK	xlii		
BERWICK-UPON-TWEED	xx	115	*ib.*
BLACKPOTS	xxxv	336	679
BLAE ROCK. (See BURNTISLAND.)	xxiv	3	
BODDAM	xxxi	299	*ib.*
BONAR BRIDGE	xxxix		
BORROWSTOWNESS	xxi	144	*ib.*
BOWLING	xlviii		
BOWMORE	xlv		
BOWMORE—ISLAY	xlv		
BRASSA SOUND—SHETLAND. (See LERWICK.)	xli	374	
BRECHIN	xxx		
BRIDGENESS	xxiii	654	*ib.*
BROADHAVEN	xl		679
BRODICK—ARRAN	xlvii		
BRORA	xxxix	359	*ib.*
BROUGHTY FERRY. (See also DUNDEE.)	xxix	213 236	
BRUCEHAVEN	xxiii	654	*ib.*
BUCHAN NESS		653	
BUCKHAVEN	xxiv		680
BUCKIE	xxxv	654	*ib.*
BURGHEAD	xxxvi	338	*ib.*
BURNMOUTH	xx		*ib.*
BURNTISLAND	xxi, xxiv	154	*ib.*
BURROW HEAD	lviii		
CAIRNBULG	xxxiv		
CAIRN POINT	lvii		
CAIRNIE	xxvii		
CALEDONIAN CANAL	xxxvii, xliv		*ib.*
CALLICOT	xliii		
CAMBUS	xxii		
CAMRUSNA GAUL BAY	xliv		
CAMPBELLTOWN	xlv	379	*ib.*
CAPE WRATH LIGHTHOUSE	xlii		*ib.*
CARNISH	xliii		
CARNOUSTIE	xxix		
CARRON, RIVER	xxi		
CARSE THORN	lix		
CARTY	lviii	596	*ib.*
CART RIVER	li	669	*ib.*
CASTLEDYKE	lix		
CASTLEHILL	xlii	374	*ib.*
CATTALINE		654	
CELLARDYKE	xxv	6 665	*ib.*
CHARLESTON	xxii		*ib.*
CHANONRY POINT	xxxviii		
Charts of Coasts of Scotland	lxi		*ib.*
CHEEK BUSH	xxix		
CLACKMANNAN	xxii	654	
CLACHNAHARRY	xxxvii		
CLACHNESSIE	xliii		
CLYDE RIVER. (See GLASGOW, GREENOCK, PORT GLASGOW, &c.)			
CLYTH	xl	661	
COCKENZIE	xviii	85	*ib.*
COLDINGHAM	xx		*ib.*
COLZEAN	lvi		
CORPACH. (See also CALEDONIAN CANAL.)	xliv		
CORRIE—ARRAN	xlvii		
CORSEWALL POINT	lviii		
Covesea, Skerries	xxxi	653	
COWIE	xxxi		
CRAIGNOON	xxvi		
CRAIL	xxvi	164	*ib.*
CREETOWN	lviii		
CRINAN	xliv		

	Report.	App.	Index.
Crinan Canal	xliv	378	
Cromarty	xxxviii	357	681
Culkeen	xliii		
Cullen	xxxv	336	*ib.*
Cumbraes	xlvii		
Cupar	xxvi		
Customs Duties	xvii	654-9	*ib.*
Dalbeattie	lix		
Debt of Ports and Harbours of Scotland	xvii	654-9	*ib.*
Devaar	xlv	653	
Dingwall	xxxviii	660	*ib.*
Donesmore	xlv		
Dornoch Firth	xxxviii		
Dredging Machine	lxii		*ib.*
Drummond Rock	xxviii		
Drumore	lviii	555	*ib.*
Dumbarton	xlvii	384	*ib.*
Dumfries	lix	598	*ib.*
Dumroof Bank		653	
Dunbar	xix	87 653	*ib.*
Dunbeath	xxxix	661	
Dundee	xxviii	194	683
Dunglass or Cove	xx		684
Dunnet Head		653	
Dunure	lvi		
Durness	xlii		
Dysart	xxiv	158	*ib.*
Earn River	xxvii		*ib.*
East Haven	xxix		
East Tarbert	xlvi	379	*ib.*
Eden River	xxvi		*ib.*
Elcho Castle	xxvii		
Elie	xxv	3 160	685 *ib.*
Elie Vows	xxv	160	
Embankments. (See Kincardine, The Tay, &c.)	xxiii xxviii		*ib.*
Embo	xxxix		
Errol	xxvii		
Eyemouth	xix	100 624	*ib.*
Fairlie	liv		
Fallin	xxii		
Ferryden	xxx		
Ferryport-on-Craig	xxvii	170	686
Findhorn	xxxvi	339	*ib.*
Findochtie	xxxv	662	
Findon	xxxi		
Fisheries	xvii	661-8	*ib.*
Fisherrow	xviii	84	*ib.*
Forse Bay	xxxix		
Fortrose	xxxviii		*ib.*
Fort George	xxxviii		
Fort William	xliii		
Forth and Clyde Canal	xxi	487	*ib.*
Forth of Firth	xx	617	687
Forth River. (See also Leith, Stirling, &c.)		487	
Fowler Rock	xxviii		
Fraserburgh	xxxiii	325	*ib.*
Freswick Bay	xli		
Friarton	xxvii		
Gaa Sands	xxix		
Gardenstone	xxxv	331	*ib.*

	Report.	App.	Index.
Garlieston	lviii	595	687
Garmouth	xxxv	337	*ib.*
Gatehouse	lviii	597	*ib.*
Gibb's Hole	lix		
Gigha Isle	xlv	661	
Girdleness	xxxii		
Girvan	lvi	554	*ib.*
Gizzing Brigg	xxxviii		
Glasgow	xlvii	385 650 667	688
Glencaple Quay	lix		
Goldspie	xxxix		
Gourdon	xxxi	260	693
Gourock	liii	517	695
Grangemouth	xxi	144	693
Granton	xxi	138 625	*ib.*
Greenock	lii	493	*ib.*
Guard Bridge	xxvi		
Halliman's Scares	xxxv		
Ham	xlii	662	
Harbours of Refuge—sites suggested for,	xix, xxxiii		695
Harbours—Want of	xvii, xxvi, xxxiv, xl		*ib.*
Harris	xlii	661	
Haven, East and West	xxix		
Hebrides	xliii		*ib.*
Helmsdale	xxxix	359	*ib.*
Heston	lix		
Highland Roads and Bridges—Commissioners of		653	696
Hilton	xxxviii	661	
Holy Isle	xlvii		
Hopeman	xxxv		
Huna	xlii		
Inch Colm		3	
Inch Garvie		3	
Inch Keith	xx	3 3	
Inchyra	xxvii		
Income and Expenditure of Ports and Harbours of Scotland	xviii	654-9	*ib.*
Inver	xxxviii		
Inveralochy	xxxiv		
Inverary	xlvii	380	*ib.*
Inverbrechie and Invergordon	xxxviii		*ib.*
Invergordon and Inverbrechie	xxxviii		*ib.*
Inverkeithing	xxiii	153	*ib.*
Inverness	xxxvi	347	*ib.*
Irvine	lv	535	697
Island Glass	xlii	653	
Islay	xlv	628	*ib.*
Johnshaven	xvxi	260	698
Jura	xliv, xlv		*ib.*
Keiss	xli		*ib.*
Kelton Scar	lix		
Kennet Pans	xxii	654	
Kilbrannan Sound	xlvi		
Kilrenny. (See Cellardyke.)			
Kincardine	xxiii	153 654	*ib.*
Kinfauns	xxvii		
Kingholm	lix		
Kinghorn	xxiv		*ib.*
Kingoodie	xxvii		
Kilmory Quay—Loch Gilphead	xlvi	380	*ib.*

	Report.	App.	Index.
Kingston	xxxv		
Kintra Bay	xliv		
Kintyre		653	
Kirkcaldy	xxiv	155	698
Kirkcudbright	lviii	597	*ib.*
Kirkwall	xli	373	*ib.*
Kyle-Akin	xliii	653	
Kyle of Sutherland	xxxix		
Laghall	lix		
Lamlash—Arran	xlvii		
Largo	xxv		*ib.*
Largs	liv	518	*ib.*
Latheron	xxxix		
Leith	xvii	1 615 667	699
Lerwick—Shetland	xli	374 628	700
Levels of Tay	xxvii		
Leven	xxv	160	*ib.*
Lewis	xliii		
Lighthouses—description of	lxi	653	*ib.*
——— want of	lxi		*ib.*
Little Ferry	xxxix	358	*ib.*
Loch-Broom	xliii	661	
Loch-Carron	xliii		
Loch-Eil	xliv		
Loch Eribol	xlii		
Loch-Fleet	xxxix		
Loch Fyne	xlvii		701
Loch Gilphead—Kilmory Quay	xlvi	380	698
Loch-in-daal	xlv	653	
Loch-Lemon	xlvii		
Loch-Lochy	xxxvii		
Loch-Ness	xxxvii		
Loch-Oich	xxxvii		
Loch-Ranza	xlvii		
Loch-Riddan	xlvii		
Loch Ryan	lvii	555 653	*ib.*
Loch-Shildaig	xliii		
Loch-Sunart	xliv		
Long Hope	xli		
Lossiemouth	xxxv	337	*ib.*
Lowlandman's Bay	xlv		
Luce Bay	lviii		
Lybster	xxxix	361	*ib.*
Macduff	xxxiv	331	*ib.*
Mail Communications—Defective state of	xxxix		*ib.*
Maw-Craig Rock	xxxiii		
May Island		653	
Meikle Ferry	xxxix		
Methill	xxv	160	*ib.*
Millport—Cumbrae	liv	518	*ib.*
Monifieth	xxix		
Monkland Canal. (See Forth and Clyde Canal.)	xxii		
Montrose	xxx	253	701
Moray Firth		653	
Morrison's Haven	xviii	85	703
Mugdrum	xxviii		
Mull of Galloway	lviii		
Mull of Kintyre Lighthouse	xlv		*ib.*
Mull Sound	xliii		
Musselburgh	xliv		
Nairn	xxxvi	340	*ib.*

	Report.	App.	Index.
New Abbey Pow	lix		
Newall	xxi		
Newdiogin	xxiv		703
Newburgh (River Ythan)	xxxiii		*ib.*
Newburgh and West Newburgh	xxvii	172	*ib.*
Newhaven	xxi	3	*ib.*
Newport	xxvii	171	*ib.*
Nigg Bay	xxxii		
Nith River. (See Dumfries.)		598	
North Berwick	xviii	86	*ib.*
Northern Lights—Commissioners of		652	*ib.*
Oban	xliv	377	*ib.*
Orkney. (See Kirkwall.)	xli		
Otter Reef	xlvii		
Oxscar		3	
Packet Stations. (See also Portpatrick and Loch Ryan.)	xlii lvii	578 564 569	*ib.*
Paisley. (See River Cart.)	li	669	*ib.*
Patterson's Rock	xlv		
Pentland Firth	xli		
Perth	xxvii	173	*ib.*
Peterhead	xxxiii	300	705
Pettycur	xxiv	155	706
Pilotage	lxi		
Pitfour	xxvii		
Pittenweem	xxv	163	*ib.*
Pittulie	xxxiv	330	*ib.*
Port Askaig—Islay	xlv		
Port Charlotte—Islay	xlv		
Port Ellen—Islay	xlv		
Port Dundas		488	*ib.*
Port Glasgow	lii	488 652	*ib.*
Port Gordon	xxxv	336	*ib.*
Portknockie	xxxv		
Portlethen	xxxi		
Port Logan—Port Nessock Bay	lviii	585	
Portmaholmack	xxxviii	358	*ib.*
Portnahaven	xlv		
Port Nessock Bay	lviii	585	
Portpatrick	lvii	559	*ib.*
Portree	xliii		703
Portseaton	xviii		
Portskerry	xlii		
Portsoy	xxxv	336 654	*ib.*
Port William—Bay of Luce	lviii	592	*ib.*
Powgavie	xxvii		
Preston Pans	xviii		
Queensferry	xxi		*ib.*
Rathlin Island	xlv		
Reep	xliii		
Renfrew	li	488	*ib.*
Rhinns of Galloway	lviii		
Rhinns of Islay	xlv		
Rispond		662	
Rocks	xxiv, xxv, xxx, xli		*ib.*
Rome Bay	xxv		
Ronaldsha	xlii	627	*ib.*
Rosehearty	xxxiv	330	*ib.*
Ross Island	lix		
Rothesay	xlvii	331	*ib.*
Ryan. (See Loch Ryan.)	lxi	555	

	Report	App.	Index.
Salen	xliv		
Saltcoats	liv	533	708
Sanda	xlv		
Sandhaven	xxxiv		
Sandside	xlii		
Sarclet	xl		709
Scrabster	xlii	375	*ib.*
Seagreen	xxxi		
Shandwick	xxxviii		
Shetland. (See Lerwick.)	xli		*ib.*
Shipwrecks	lx		*ib.*
Shipping and Tonnage	xvii	653 654-9 660 661	708
Sinclair Bay	xli		*ib.*
Skateraw	xix		
Skegasta	xliii		
Skerrat Rock	xliv		
Skerrievore	xliii	653	
Skipness	xlvi		709
Small Isles	xlv		
Solway Firth	lix	652	*ib.*
South Esk River. (See Montrose.)	xxx		
Southerness	lix		
St. Abb's Head	xix	3	
St. Andrew's	xxvi	165	*bi.*
St. Catherine's Pier	xlvii		
St. Combs	xxxiv		
St. David's	xxiii	153	*ib.*
St. Margaret's Hope	xxiii	3	*ib.*
St. Monance	xxv		*ib.*
St. Ryonald's Bay	xlvii		
Starlie or Stanley-burn	xxiv		*ib.*
Staxigoe	xli		
Stirling	xxii	145	*ib.*
Stonehaven	xxxi	261	*ib.*
Stornoway	xliii	376	710
Stotfield. (See Lossiemouth.)	xxxv	337	701
Stranraer	lvii	558	710
Stromness	xii	628	*ib.*
Sunburgh Head		653	

	Report.	App.	Index
Tarbet Ness	xxxviii		
Tain or Dornoch Firth	xxxviii		
Talmine	xlii		
Tarbert, East and West	xlvi	379 629	710
Tay River. (See also Dundee and Perth.)	xxvi		*ib.*
Thurso	xlii	375	*ib.*
Time Ball	xxvi	3 81	
Tobermory	xliii	377 628	*ib.*
Tongue	xlii		
Trinity Pier	xxi		
Troon	lv	538	*ib.*
Tweed River. (See Berwick.)	xx	115	
Uist	xliii		
Ullapool	xliii	661	
Unst—Shetland	xlii		
Urr—Water of	lix		
Utrigoe	xl		
Uzon	xxxi		
Voltos	xliii		
Vows of Elie. (See Elie.)	xxv		
Wades Bay	xxv		
Walls—Shetland	xlii		
West Haven	xxix		
West Newburgh and Newburgh	xxvii	172	711
West Tarbert	xlvi	629	
Westray		662	
West Wemyss	xxiv		*ib.*
Whaligoe	xl	663	
White Farlane Bay	xlv		
Whitehills	xxxv	336	*ib.*
Whithorn	lviii	594	*ib.*
Whiting Bay	xlvii		
Wick	xl	363	*ib.*
Wigtown	lviii	596	712
Woodhaven	xxvii	171	*ib.*

A SUMMARY REPORT ON THE STATE OF THE HARBOURS OF SCOTLAND,

BY THE EXAMINING COMMISSIONER,

IN SEPTEMBER AND OCTOBER, 1846.

SCOTLAND.

A Summary Report on the Harbours.

SINCE the publication of the Second Report and Appendix of this Commission in August, 1846, I have, in company with Captain Vetch, R.E., Admiralty engineer, visited most of the ports on the east coast of Scotland, from Berwick-on-Tweed to the Pentland Firth; and on the west coast, Glasgow, with the ports on the Clyde, those in Ayrshire, and in the Solway Firth.

This more extended examination fully confirms the view taken by the Commission in its First and Second Reports; and, although, generally speaking, the Scottish ports are better managed than those on other parts of the coasts of the United Kingdom, still there are few cases, among the many that have come before us, in which so much of Government control as has been recommended by the Commission would not have been the means of saving unnecessary outlay, of obviating evils arising from neglect, or of preventing obstructions to the tidal flow, or encroachments which now can with difficulty be remedied.

App. No. 491.

Scotland, without including the numerous inlets on the west coast of Sutherlandshire, the Hebrides, and the Orkney and Shetland Isles, contains 140 harbours, at which dues are levied under authority of ancient charters, Acts of Parliament, &c. The whole income arising from this source amounts to about 194,000*l.* a-year; the debt at the close of the year 1846 was 1,566,490*l.*, or eight times the revenue.

Shipping Rep., 1847.

The shipping belonging to these different ports consists in 3632 vessels, of 503,040 tons; while the annual arrivals and sailings of vessels carrying cargo, which indicate the chief traffic, are 52,817 vessels of 4,873,374 tons. The gross customs duty received in Scotland during the year 1846 was little short of two millions sterling.

App. No. 491.

Fishery Rep. 1846.

This traffic is exclusive of vessels in ballast, passenger steamers, ships of war, revenue cruizers, and coasters carrying stone, lime, &c.; and these, including the daily trips of steamers, swell the whole to the large number of 150,000 arrivals and sailings annually. It is also independent of the fisheries around the coasts, which, even in their present imperfectly developed state, and although cramped by the want of sheltered harbours, piers, and landing places, employ 10,535 boats, manned by 40,758 men and boys, besides 32,270 tons of shipping occupied in the carrying trade immediately in connexion with the fishery.

LEITH.

LEITH, the port of the capital of Scotland, has a large foreign traffic in corn and timber, in addition to its coasting trade. The arrivals last year were 5309 vessels of 387,384 tons, of which 672 were steamers; 863 vessels were from the colonies and foreign, and the custom dues amounted to 578,590*l.* The tonnage belonging to the port, including 16 steamers, consists of 213 vessels of 23,026 tons.

See plan, p. 138.

App. No 5.

App. No. 7.

App. Ev. p. 3.

The harbour is formed by the outlet of the Water of Leith, which has been guided across an extensive foreshore of flat sand by a pier on its eastern side, added to at various periods, and now 833 yards in length, reaching out to low-water mark. So great was the increase of traffic towards the close of the last century, that Rennie was consulted in 1799 as to the best means of providing harbour accommodation. He proposed a plan for wet docks, extending westward, with a deep-water entrance off Newhaven; two of the wet docks, having an area of 10½ acres, with three graving docks on the north side, were completed in 1817, at a cost of about 260,000*l.*; but in lieu of the proposed western outlet, an entrance, 36 feet wide, was made from the old dry harbour. Nothing further was done until 1828, when, at the recommendation of Chapman, the east pier was extended 500 yards, and a west pier or breakwater, constructed in order to quiet the inner harbour, and form an outer harbour. Other improvements have recently been carried into effect; the harbour has been deepened 3½ feet by dredging; the eastern pier has been completed to low water, and leading lights have been erected; a rubble-stone cross-weir has been placed to prevent the drift sand from coming into the channel; the sills of the docks have been lowered to within 6 inches of the level of low water at spring tides; and the harbour revenue has increased to 26,000*l.* a-year.

App. No. 5.

App. Ev. p

App. Ev. p 3.

It is fully admitted that a long flat foreshore, half a mile in extent, drifting sand, and other difficulties which had to be encountered in improving the harbour were great, but not such that unanimity on the part of those who had the management, skilful engineering, and perseverance in carrying out the plan recommended, might not have overcome. The great principle of improvement at Leith, namely, to get a deep-water entrance to the harbour channel, whether to the westward or to the eastward, has been recognised by all the eminent engineers who have been consulted; yet although more than a quarter of a million of public money has been laid out in its docks and other works (an advantage not enjoyed by any other harbour in Scotland), and its income latterly has exceeded 25,000*l.* a-year, still there is so great a want of accommodation that vessels are obliged to lie four and five abreast alongside the quays; there is no patent-slip nor graving-dock that can take in steamers, so that they have to be sent to Dundee or to

SCOTLAND.

London for repair; no low-water jetty for landing passengers and light goods; and the entrance to the harbour at low tides is all but dry.

App. Ev. p. 3.

App. Ev. p. 3.

Indecision or half measures seem to have been the bane of the port; it was obvious, some twelve years since, that nothing but a good low-water landing place, to accommodate the passenger traffic between London and Edinburgh, could retain the large steamers at Leith. Instead of boldly grappling with the difficulty, taking the best advice, and at once deciding upon carrying out a wide substantial pier (to the westward or to the eastward, as might have been found expedient) into 10 feet depth of water, an eastern pier, too slight and narrow and too exposed to bear the traffic or to lay a line of rails upon, has taken sixteen years to complete, and has just reached low-water mark, the consequence is, as might have been anticipated, that most of the steam-boat traffic has been transferred to a neighbouring pier, and the loss to the harbour revenue is stated at 5000*l*. a-year. Complaints are made that the table of shore-dues has not been revised for the last 60 years; that it is full of anomalies; that the dues are levied in Scottish money; and that dock dues are exacted of vessels that cannot possibly pass the dock gates; that rubbish and filth, without check or control, is thrown into the Water of Leith and washed down into the harbour, and that the fine steamers that trade between London Hull, and Leith are daily subjected to lie aground, with the risk of strain to their hulls and to their machinery in a dry harbour.

App. Ev. p. 1.

1 & 2 Vict. c. 55.

App. No. 20.

App. Ev. p. 3, 4.

For a long period the harbour was under the management of the provost and magistrates of Edinburgh, while a portion of the revenue was applied to municipal purposes, and eventually the port shared in the financial embarrassments of the capital. In 1826, its management was transferred to 21 Harbour Commissioners; and these, in 1838, were further reduced to eleven, five of whom are appointed by the Treasury: this number is found to be ample for all purposes. By the last Act an annual sum of 7680*l*., out of the harbour income, was secured to the city of Edinburgh, in payment of an alleged debt, due from the port to the city. A part of this money is made over to the city creditors, but the greater portion is appropriated to the support of ministers of the Church of Scotland, and for education; both doubtless admirable objects, but it is not easy to understand why the shipping interest should be specially made to contribute to their maintenance, nor how the port of Leith, that for nearly thirty years contributed 15,000*l*. a-year from shore dues and dock dues to the funds of the city, can still be indebted so largely to the Town Council of Edinburgh. It appears in evidence that three naval officers, the Government nominees on the Leith Harbour Board, were summarily dismissed a few years since, without any reason for their removal being assigned; and that the master of the Trinity House was not re-elected a member of the Board because he differed in opinion from the Leith Town Council as to the best mode of improving the harbour.

See plan, p. 138.

App. No. 16.

App. No. 21.

During the present session a Bill has been brought into Parliament for revising the schedule of rates, and to empower the Commissioners to carry out a plan for improvement recently proposed by Mr. Rendel. This plan agrees with that of Mr. Walker in 1839 in maintaining the eastern entrance; it extends the eastern pier 330 yards into 8 feet at low-water springs, and the western for 600 yards, nearly parallel to the former, thereby confining the channel which it is proposed to dredge to a depth of 6 feet at low and 24 feet at high-water spring tides. The entrance is to be 200 feet in width, and to face north-north-west. The west pier is to be substantial enough to bear a railway, and a landing-place is to be made at the end of it. It is also proposed to form a wet-dock of 4¾ acres to the northward of and parallel to the present east dock, with an entrance 60 feet wide, capable of admitting the largest steamers. Estimate, 135,000*l*.

FISHERROW.

3 Vic. c. 73.

App. No. 25.

FISHERROW, the harbour of Musselburgh, has an area of about two acres, enclosed by stone piers (one of which has been recently rebuilt), with an entrance between 70 feet in width, facing the north, and a depth of 10 feet at high-water spring tides at the pier heads; the dues last year, levied by authority of an Act of 1840, were 812*l*., and its debt was 7073*l*. Besides its 68 fishing-boats, employing 340 men and boys, it has a fair district trade in timber, bark, coal, &c., and the arrivals in 1846 were 457 vessels of 20,027 tons; of which 39 vessels were from the colonies or foreign.

MORRISON'S HAVEN.

App. No. 28.

MORRISON'S HAVEN, the harbour of the estate of Preston Grange, is formed by an east pier, with an elbow parallel to the shore, enclosing a space of 4 acres; the width of entrance is 70 feet, with a depth of 14 feet at high-water springs. The arrivals in 1846 were 53 vessels of 3718 tons, of which 7 vessels were from foreign. The dues, levied in virtue of a charter of James V. in 1526, were 63*l*. Prestonpans, a mile to the eastward, has 40 fishing-boats, and Port Seaton 12, employing between them 234 men and boys.

COCKENZIE.

App. No. 30.

COCKENZIE is a private harbour, constructed in 1833-4, by the proprietor of the adjoining collieries for the purpose of shipping coal. It has an area of three acres, with an entrance 90 feet in width, and a depth of 15 feet between the piers; it is of easy access, and may be taken at tide time in any weather. It is an excellent small harbour, and, if required, is capable of great improvement. The arrivals in 1846 were 144 vessels in cargo of 12,811 tons; of these, 54 vessels were from the colonies or foreign. The dues levied by "mutual consent" were 50*l*. It is the head-quarters of 35 fishing-boats.

NORTH BERWICK.

App. No. 32.

NORTH BERWICK is a small but useful harbour, of about three quarters of an acre in extent, enclosed by piers; the entrance is 25½ feet wide, with a depth of 13 feet at the pier heads; it is not easy of access, but once entered, it can be secured from bad weather by boom-gates.

Branches from the North British Railway are in progress to North Berwick, Cockenzie, and

SCOTLAND.

Morrison's Haven. The arrivals in cargo in 1846 were 65 vessels of 1941 tons; the dues, levied by charter of James VI. granted in 1568, were 71*l*. The locality of North Berwick on the most projecting part of the coast of East Lothian, is well marked from a distance by the great leading objects, the Bass Rock and North Berwick Law, and it has been considered by some persons favourable for the site of a national harbour to shelter coasting vessels waiting for a wind, or as a look-out station for war-steamers.

DUNBAR.

DUNBAR, at the entrance of the Firth of Forth, is a valuable fishery station, and from its proximity to the best fishing ground, and the facility of land-carriage by the North British Railway, it is likely to become a chief resort of fishing-boats in this part of Scotland: fully 300 boats, 28 of which belong to the place, fished from the harbour during the last season. A new harbour, of 2½ acres in extent, has recently been constructed here by the Fishery Board, at the joint expense of that board and the burgh; the whole cost of it was 15,762*l*., of which sum 11,262*l*. was contributed by the Fishery Board on the part of the public. The entrance of the harbour is narrow, being only 70 feet wide, and it is represented as extremely difficult of access; it appears, from the evidence of the fishermen, that the run of the swell is so great, and the sea that falls over the parapet wall (although it rises 20 feet above high water) is so heavy, that no vessel can lie alongside the new quay in blowing weather. A small additional sum spent in straightening the entrance and deepening the interior, in forming a quay by the deep water along the rocks close outside the entrance, and in effecting a junction between the old and new harbours, would be a great benefit; and without which much of what has been done is in a great measure labour lost. The arrivals and sailings in 1846 were 356 loaded vessels of 15,069 tons, of which 35 vessels were from or to the colonies or foreign. The tonnage belonging to the port consists in 23 vessels of 1290 tons; the revenue is 425*l*., and the debt chiefly incurred in building the new harbour, 6151*l*.

See plan, p. 138.
App. Ev. p. 89.
See section, p. 668.
App. No. 492.

Dunbar has long been pointed out as an eligible situation for a harbour of refuge, and its position, near the entrance of the Firth, in the immediate track of the numerous shipping that trade along this part of the east coast, the many wrecks that have taken place in its immediate vicinity, and the outlying rocks, or small islands, which might form the abutments of a breakwater, are strong points in its favour.

App. No. 42.
App. No. 43.
App. No. 488.

EYEMOUTH.

EYEMOUTH HARBOUR is formed by the outlet of a mountain stream falling into a small bay which is sheltered by the outlying group of the Hurcar Rocks, that extend as a natural breakwater across its entrance, leaving a passage in on either side. The mouth of the river is protected from the heavy run of the sea by a stone pier (one of Smeaton's earliest designs), carried out from the eastern shore in 1768, and by a short pier on the west side, with an entrance between 154 feet in width, having 14 feet depth at high-water spring tides. A quay wall, rebuilt in 1843, along the middle of the river, forms an inner basin, and gives great shelter to vessels lying at the quays against the river freshes, which occasionally bring down large quantities of gravel, and do much damage to the harbour.

See plan, p. 138.

It appears in evidence, that the old pier and the river-wall along the ballast quay, are out of repair; that there is no crane on the quays, nor any warping-buoy off the harbour's mouth; that the bed of the river requires to be deepened, and the rocky skares to be removed; that there is no beaching place in the harbour to run a vessel on in case of need; no light at the pier-head, nor any beacon on the Inner Buss, a dangerous rock which lies in the fairway of the entrance to the bay.

App. Ev. p. 101.
App. Ev. p. 101.

Eyemouth is the head quarters of an important fishing district, extending 30 miles along the coast, employing 166 boats and 823 men and boys; 48 boats of this number belong to Eyemouth and 29 to Ross and Burnmouth, the creeks immediately adjacent. The arrivals in the past year were, 305 vessels of 13,067 tons; of these, 30 vessels were from foreign. The revenue levied by Act of 1839, is 314*l*., and the debt incurred by building the quay-wall and deepening the harbour, 2000*l*.

Fishery Rep., 1846.
2 Vict. c. 36.

Eyemouth has long been spoken of as a favourable spot for an asylum harbour, and the shelter afforded by the outlying Luff Hard and Hurcar groups of rocks, and its position as the nearest harbour to St. Abb's Head, the turning point of this part of the coast, are much in its favour. The apparent extent, also, of sheltered anchorage when viewed from the heights around at high water encourages the opinion; but an accurate survey, made under the directions of the Admiralty, in 1839, has shown the rocky character of the bay, and the deep-water space to be so limited that if the proposed breakwater were constructed, it would not shelter anchorage sufficient for a dozen loaded vessels to ride afloat.

App. No. 49.
App. No. 53.
See plan, p. 138.

ST. ABB'S HEAD.

That an asylum harbour is much needed along the part of the coast between Holy Island and the Bass is proved by the fearful list of wrecks in this vicinity printed in the Appendix, and by the large and increasing traffic that daily passes along these shores. But when the subject comes under consideration—and it is ardently to be hoped that that day may not long be deferred—it must be viewed apart from all local bias; the safety of shipping and the lives of seamen, public benefit and national defence, must be held paramount to all other considerations. The long deep bay between St. Abb's Head and the Bass Rock is notoriously the most dangerous on this part of the coast; in north-easterly gales, when once embayed, vessels rarely escape from it, and we believe it will be found that most sailors, not influenced by local connexion, will point to the immediate neighbourhood of Skateraw, lying about half way along the bight, as combining several natural advantages for such a harbour. In the mean time, without offering an opinion on the subject, it is submitted that it may be worthy of consideration, whether a light placed on St. Abb's Head might not be the means of saving a portion of the wrecks that occur in this bay. This prominent headland forms the turning point of the coast that is daily passed by the whole trade of Leith and the Firth of Forth with Hull and

App. No. 43.
Admiralty
Ap

SCOTLAND.

London, and there is no coast light between the Farn and May Island, a distance of 45 miles, or rather between the Farn and Inch Keith, an extent of 60 miles, comprising the bay under consideration.

DUNGLASS.

See section, p. 668.

DUNGLASS, or Cove, is a small fishing harbour, formed by a north and south pier, with an entrance between 72 feet in width, built in 1831; it has 7 boats. Coldingham has a substantial pier to the eastward, with a parapet rising 12 feet above high water, and two short breakwaters; entrance, 20 feet wide, facing north, built in 1832, at a cost of 1525*l.*; it has 20 boats. BURNMOUTH has an east pier, with a north elbow within an opening in the rocks: it was built about 1830, and has, with Ross, 29 boats, employing 145 men. This is a favourite creek with fishermen, as, owing to the protection afforded by outlying rocks, they can take it when they cannot attempt Eyemouth or Berwick. Three-fourths of the expense of these harbours were defrayed by the Fishery Board, and the remainder by the fishermen at each creek.

BERWICK-UPON-TWEED.

See plan, p. 138.

App. No. 60.

See section, p. 668.

BERWICK-UPON-TWEED, from its position in the midst of a highly-cultivated and fertile country, with an extensive coal-field in its immediate neighbourhood, and on the banks of a river that drains a larger area than any other in Scotland except the Tay, possesses great natural advantages. Its harbour is formed by the outlet of the Tweed, which falls into the sea at one mile below the bridge, between a stone pier on the north and a long, low, sandy spit, serving as a natural breakwater, on the south. The width of entrance is 120 yards, with a depth, over a rocky bar, of 4 feet at low water, and 19 feet at high-water spring tides. The north pier, the great feature of the harbour, was designed by Rennie in 1807, and completed in 1822; it stands on the site of a former pier, said to have been erected in the time of Edward VI., is built of rubble sandstone, faced with ashlar, and presents a nearly upright face to the sea; it is 830 yards long, by 13 yards medium width, and 8 yards in height, and cost 72,000*l.*

App. Ev. p. 116.

48 Geo. III. c 104.

In addition to the pier, quay walls have been built on the north side of the river, near the bridge, and two timber steam-boat jetties lower down. A quay was also formed in 1836, at the Carr Rock, on the south side, and a road carried from it to Spittal. A lighthouse has been erected at the pier head, and a portion of the river deepened about 4 feet by the steam dredge. The harbour is governed by Commissioners appointed under an Act of the year 1808; the original number was 18, they are now 15, three of whom are non-resident, and therefore, *de facto*, no longer Commissioners. The traffic of the port consists in 737 arrivals of 47,126 tons, including two steamers, plying weekly to Hull and to London. Of these vessels, 66 of 7771 tons were from the colonies and foreign. The harbour revenue in 1846 was 3222*l.*, and the debt 9675*l.*; the customs duty of the port for the past year amounted to 15,728*l.*

App. Ev. p. 116.

App. No. 72.

App. No. 70.

App. Ev. p. 116.

App. Ev. p. 118.

App. No. 71.

It appears in evidence, and from statements printed in the Appendix, that several complaints are made against the management of the affairs of this trust. It is alleged that the Commissioners are self-elected; and that, in filling up vacancies, the general interests of the port are not attended to; that while agriculture, the salmon trade, and other trades have each its representative, there are but few shipowners, and not a single sailor at the Board; that the schedule of dues is partial and unjust, nor has it been revised since the year 1808: and that while corn and salmon pay nominal dues, the white fishery and salt are heavily taxed. That the south side of the river, especially at Tweedmouth, where are the chief factories, is left without quay, jetty, or any landing place whatever, while the accommodation at Spittal is very insufficient, and that in consequence (in addition to other inconveniences), while the residents on the south side contribute their full share of shore dues, all their goods, whether exported or imported, are subject to a vexatious bridge toll, from which those in Berwick are free. Complaints also are made of the heavy swell that ranges along the quays in easterly gales, and that no attempt has been made to remedy it; that the foundation of the pier is so shallow that it will not admit of the harbour being deepened another foot without its being secured; and that several stones have already been washed out of the face of the building. That the owners of the salmon fisheries have caused much opposition generally to harbour improvements, and even to the completion of the pier, whereby the expense was much increased; that numerous salmon batts exist below the bridge, and that, in short, the harbour has been sacrificed to fishery purposes. That the cost of the pier has been unnecessarily large; that Tweed Bridge, with its fifteen narrow arches, heavy piers, and additional starlings, is a great obstruction to the fair scour of the tide, which at times flows up eight miles beyond it; and lastly, that the accounts of the Harbour Trust, which by Act of Parliament are directed to be annually laid before the Town Council, are tendered in such a form as to be utterly useless for the purpose of enabling the rate-payers and the public to check the expenditure, thereby defeating the obvious intention of the Legislature in inserting this salutary clause in the Harbour Act.

FIRTH OF FORTH.

Admy. Chart, 1847.

Lighthouse Rep., 1846.

Returning to the northward, we enter the FIRTH OF FORTH, the most capacious inlet of the sea on the eastern coast of Great Britain, alike valuable for its large amount of traffic, and as affording the only real refuge in an easterly gale on this part of the coast. Assuming its limits to be a line adjoining St. Abb's Head on the south, and Fifeness on the north, the firth is navigable at all times for vessels of 12 feet draft as far as Grangemouth and Kincardine; and, at tide time, to Alloa and Stirling for a distance, including windings, of 54 miles. Within this space are comprised 40 pier and tidal harbours, besides the well-known roadsteads of Leith Aberlady, and Largo Bays, and the sheltered anchorage of St. Margaret's Hope. It may aid in forming some estimate of the traffic of these several harbours to state that 18,536 vessels, of 1,532,603 tons burthen, paid dues, in 1846, for the Inch Keith Light in the middle of the firth, exclusive of ships of war, revenue cruizers, vessels in ballast, fishing-vessels, and all under 15 tons burthen.

NEWHAVEN.

At NEWHAVEN, a mile to the westward of Leith, a substantial stone pier and slip, extending to low water, with a return head to the westward, was erected at the joint expense of the Crown and the Trustees of the Fife Ferries, and is now undergoing considerable repairs. It forms a small harbour for wherries and fishing-boats, but a much larger one is wanted for the 180 boats which belong to the place, and employ the numerous fishermen who reside in that neighbourhood. The Fife and Mid Lothian ferries, formerly between Kinghorn and Newhaven, were transferred to Granton and Burntisland, in September, 1844. At Trinity, about 500 yards west of the stone pier, a chain pier was erected in 1821, at an expense of 4000*l*; it is 170 yards long, and reaches to a depth of 5 feet at low water; it was formerly used by the Fife steamers, and by those plying to Alloa and Stirling. App. No 75.

Between Newhaven and Leith, and particularly under Leith Fort, the sea has made great inroads upon the shore, and much inconvenience has been caused by the coast-road having been destroyed, as well as great loss to Government and other property.

GRANTON.

At GRANTON and at Burntisland, on opposite sides of the Firth, the Duke of Buccleuch and Sir John Gladstone have recently erected admirable low-water piers, which afford great accommodation to passengers, and form the connecting link between the lines of railroad shortly about to unite the metropolis with the Highlands of Scotland. Granton pier was begun in November, 1835, partly opened in June, 1838, and finished in 1845. This magnificent erection is built of stone from the neighbouring quarries, it is 570 yards in length by 60 yards in breadth, and has a depth of 10 feet at its outer end at low water, and 28 feet at high-water spring tides. It is amply furnished with jetties, slips, cranes, and every requisite for a complete pier; a red light is exhibited at the pier end, where there is also a self-registering tide-gauge, the only one yet erected in Scotland. It formed part of the original plan to construct breakwaters at about 500 yards distant to the eastward and westward of the centre pier; the western arm is just begun. See plan, p. 164. App. No. 74.

A branch of the Edinburgh and Northern Railway will shortly be led down on the east side of the pier, and arrangements are in progress for working the cranes by hydraulic power. The traffic at the pier is already very extensive, and likely to increase; during the past year, it shows a return of 1579 voyages, employing, in and out, 382,891 tons of shipping; the number of passengers landed and embarked were 171,616; while sheep and cattle averaged 40,000 head. App. No. 75.

QUEENSFERRY.

At SOUTH QUEENSFERRY is a small district harbour enclosed by piers; it is better known as the great thoroughfare across the Firth, but which really takes place at the village of Newall, a short distance to the eastward, where is a substantial low-water stone pier or slip, whence the half-hourly passage is kept up by a steam ferry-boat, under the management of trustees.

BORROWSTOWNESS.

BORROWSTOWNESS, or, as usually termed, Bo'ness harbour, has an area of about one acre, enclosed by piers, with a scouring basin; it has also a patent slip: it is of easy access, and had formerly considerable trade; but this has much fallen off since the opening of the canal at Grangemouth, and it was until lately much out of repair. The expense of an Act of Parliament in 1844, preparatory to its improvement, amounted to 900*l*., or double the gross annual income of the town and harbour. The arrivals in 1846 were, 719 vessels of 29,663 tons, of these, 22 vessels were from the colonies, or foreign, and the customs duty received, 1856*l*. The tonnage belonging to the port was 91 vessels of 3944 tons, the revenue, 503*l*., and the debt, 2380*l*. An embankment extends from this place about one mile and a-half westwards along the north side of the Carse of Kinneil. 7 Vict. c. 69. App. No. 76.

GRANGEMOUTH.

GRANGEMOUTH, the eastern entrance of the Forth and Clyde Canal, at the confluence of Grange-burn with the Carron, is a thriving place, and the harbour has recently been enlarged and improved by a wet-dock of 4 acres, and timber basins of 17 acres in extent. The channel of the Carron is confined to a width of 120 yards by well-built embankments faced with stone a mile in length from the mouth of the Grange to low-water mark on the Forth, whereby a depth of 21 feet at high-water springs, and of 17 feet at neap tides, is secured up to the docks: it is proposed to deepen the low-water channel to 5 feet; and a lighthouse is now being erected to mark the eastern approach to the harbour. See plan, p. 164.

The entrance to the dock is by a lock 250 feet long and 55 wide, capable of admitting large steamers. The traffic of the port in 1846 consisted in 2406 arrivals and sailings in cargo of 208,964 tons, of which 790 vessels of 89,040 tons were to or from the colonies and foreign. The revenue was 1838*l*., and the customs duty amounted to 21,103*l*. App. No. 492. 4 Vict. c. 35.

FORTH AND CLYDE CANAL.

The FORTH AND Clyde CANAL affords a navigable channel between the east and west coasts of Scotland, for vessels not exceeding eight and a-half feet draft of water. The near approach of the Firths of Forth and Clyde, and the tract of low land intervening between them, early pointed out this line as a favourable site for a canal that might save some 500 miles of rough and intricate navigation through the Pentland Firth, and the Great and Little Minch.

In the reign of Charles II., it is said that a project was formed for a ship canal, capable of admitting transports and vessels of 500 tons burthen; if so, it is to be regretted that such a plan was ever departed from. In 1723 and 1761 it appears that a similar project was set on foot, and finally, in 1768, the Forth and Clyde Navigation Company was formed, a modified plan was decided upon, at an estimate of 150,000*l*., and the work was begun at the east end, under the direction of Smeaton, and persevered in till 1777, at which time it had reached Hamilton Hill, near Glasgow. But, as in most similar undertakings, the expenditure far exceeded the estimate, and some doubts arose as to completing the work: however, in 1784, Government granted 50,000*l*., out of the rents of the forfeited estates in Scotland, towards the project; in July, 1786,

SCOTLAND.

the cutting of the canal was resumed, under Whitworth, and in July, 1790, it was completed from sea to sea.

The length of the navigation direct from Grangemouth on the Forth to Bowling Bay on the Clyde, is 35 miles; the side branch to Port Dundas at Glasgow is 2¾ miles, and the continuation to the Monkland Canal 1 mile; total 38¾ miles. The number of locks on the eastern side is 20, and on the western 19, the difference being partly caused by the higher level of the tide at high water in the Clyde than in the Forth. Each lock is 74 feet long, 20 feet broad, with a lift of about 8 feet. The summit level of the canal is 141 feet; its average width at the surface is 56 feet, at the bottom 27 feet; its depth 8½ feet. The canal has six reservoirs, covering about 400 acres, containing 12,000 lockfulls of water. The cost, including all expenditure up to its completion, was 330,000*l.*

The affairs of the Company appear to be judiciously managed, and notwithstanding a recent reduction in the tonnage dues, they continue to be remunerative, and to embrace an extensive traffic. The revenue for 1839, the highest attained, amounted to 95,475*l.* Locomotive steam-engines were applied in that year as a substitute for horses in towing the canal-boats, and it was found that they could be carried along at the rate of 18 miles an hour without injury to the embankments, but this mode was not adopted for general traffic. The tolls on the canal do not exceed 1½*d.* a-ton per mile. In 1846 the Monkland Canal, 12 miles in length, was incorporated with that of the Forth and Clyde, and the whole cost of these two canals, up to the present time, has been 1,090,380*l.*; the whole revenue of the past year was 115,621*l.*, and the debt now due for borrowed money is 171,350*l.*

STIRLING.

See plan, p. 164.

7 Vict. c. 47.

App. No. 83.

App. No. 81.

STIRLING, as the natural emporium of the Western Highlands, and from its position on the banks of a fine river, with a large rise of tide, should be the outlet of an extensive district of fertile country. Instead of this, seven fords or shallows, easily removable, cross the river between Stirling and Alloa, and oppose a barrier to navigation; and a weir at Craig Forth, five miles above the town, stops the upward flow of the tide, while the money raised under an Act of Parliament for removing these obstacles, and improving the river, has been wholly consumed upon the expenses attendant upon procuring that Act, which was obtained only for the public benefit. The Town Council of Stirling have taken the first step in the right direction, by engaging Messrs. Stevenson to make a detailed and careful survey of the river, and of the rise of its tides (which present some peculiar features), with a report on its capabilities for improvement, which it is to be hoped the Commissioners of the Forth navigation will lose no time in carrying into effect. The arrivals and sailings last year were, 45 loaded vessels of 1905 tons; the revenue was 500*l.*, and the debt 1600*l.*

ALLOA.

43 Geo. III. c. 55.

At ALLOA, with considerable trade, both coasting and foreign, the dock and quay walls are falling into the stream. The arrivals and sailings last year were, 439 loaded vessels of 31,940 tons, of which 78 vessels were to or from the colonies, or foreign; and the customs duty was 1859*l.* The harbour revenue, derived from very slight dues on goods and shipping, was 725*l.* in 1846. At Clackmannan Pow, Kennetpans, and Fallin, creeks of the port of Alloa, it appears that no dues are paid; the arrivals and sailings in 1846 were respectively 227, 10, and 7 loaded vessels, and 28 at Cambus, the revenue of which was 50*l.*

App. No. 85.

43 Geo. III. c. 159, s. 11.

It is with regret we are compelled to add that great complaints are made of the long-continued practice of shipmasters throwing their ballast into the Forth, on their passage from Queen's Ferry up the river to Alloa and Stirling. This practice has considerably increased since the opening of an extensive colliery in Clackmannan, a few years ago, the coal from which is shipped at Clackmannan Pow, about a mile and a-half below Alloa, which is daily resorted to by numerous vessels engaged in the coal trade, and the constant custom of the masters is to throw their ballast over their ships' side into the river; and though this pernicious practice, so injurious to navigable rivers, is expressly prohibited, under high penalties, by Act of Parliament, yet no notice has been taken of it by the authorities either in Clackmannan or Stirlingshire.

App. No. 85.

Very much to their credit, the trustees of the harbour of Alloa did interfere to endeavour to prevent it. They employed two men to watch the river, in the year 1842, and at different times, both before and since, and a few convictions followed on prosecutions instituted by them. But these have not had the effect of stopping the practice, and the consequence is, that the shoals and banks of the river have of late greatly increased, and new banks are being formed; the steam-vessels which ply daily between Granton and Alloa, and Stirling, often run aground on these banks, and the passengers have frequently to be conveyed in small boats to the pier at Alloa. Within these twenty years loaded vessels, from 60 to 70 tons burthen, could pass freely up and down the river, to and from Alloa, at low water, but now the passage of the river is so obstructed that such vessels can with difficulty get over the banks. The practice complained of is not confined to this part of the river only, but prevails to a great extent in the neighbourhood of the harbour of Charleston (where large quantities of coal and lime are shipped) and, it is to be feared at nearly every other harbour in the Firth.

54 Geo. III. c. 159.

To inflict the full penalty under the Act on all occasions might check this evil, but there is great difficulty in getting informations laid, nor is it generally known that half the penalty goes to the informer. A more effectual mode of stopping it would be to refuse any shipmaster his clearance at the custom-house until he had given proof that he had deposited the whole of his ballast at a ballast quay, or some other lawful place, which all harbour-trustees should be bound to provide.

Hyd. Off. 1847.

Nor is this the only evil to which this once fine navigable river is subject; it appears that, besides the well-known Blair Drummond clearance (from the year 1776 downwards, of 1450 Scottish acres of moss), another landed proprietor, on the banks of the Forth above Stirling,

SCOTLAND.

has more recently cleared away, or, as it is termed, "floated off" some hundreds of acres of moss, which he also threw into the river; and large heaps of the lighter portions may be seen floating about on a spring tide, besides much that is lying on the shore near high-water mark.

Admy. Chart, 1847.

The inevitable result of such reckless conduct it is not difficult to predict; indeed it is already manifest, as by the recent Admiralty Survey of this part of the Forth it appears that a vessel drawing only 12 feet water cannot lie afloat at low-water spring tides at a quarter of a mile above Kincardine; that a vessel drawing 7 feet could not, at similar tides, scrape her way up to Kennet Pans; and that a boat drawing 2 feet water would ground in the attempt to reach Clackmannan Pow, lying a mile and a half below Alloa. Yet, as seen above, "within twenty years, vessels of 60 and 70 tons burthen, with their cargoes (probably drawing from 8 to 9 feet), App. No. 85. could pass up and down to and from Alloa at low water." Surely some control is needed here.

KINCARDINE.

At KINCARDINE, besides a quay, there is a stone pier or slip, 239 yards long, and extending into 6 feet at low water, erected in 1826, by the proprietor of the adjoining estate, whence is a steam-ferry to a timber jetty of 256 yards, and an embankment 186 yards long, on the south shore, thus narrowing the river to a width of only 426 yards The cost of the two piers was 6468*l*. The arrivals last year were, 64 vessels of 3160 tons, of which 4 vessels were from the colonies or foreign. The revenue was 60*l*.

50 Geo. III. c. 29.

Immediately above and below Kincardine, 366 acres of the alveus or bed of the river, between high and low water, have been embanked, without the sanction or even the knowledge of the Admiralty; and the success of the measure has been rewarded by the premium of the Highland Agricultural Society. Transactions, 1838. The upper or western portion of this encroachment consists of 152 acres, and the line of embankment was placed in a depth of 8 feet water at spring tides; the work was completed in 1821-2 at a cost of 6500*l*. The lower or eastern portion has an area of 214 acres, and was carried out in the years 1829-38 at a cost of 13,000*l*. The east end of its line of embankment, near Longannet, was placed in a depth of 11½ feet water, thus occupying the space that nine-tenths of the vessels that trade to Alloa and Stirling would have floated in, and would have made use of in working up the Forth against a contrary wind. The fact affords an additional illustration of the utter indifference manifested on all sides to the rights of navigation and the public.

1 & 2 Will. IV., c. 3

It is further proposed to make (and an Act of Parliament exists said to authorize them) much more extensive embankments in this neighbourhood, on the south or Linlithgow side of the Firth; it is understood that 750 acres of the sleeches or alveus between high and low-water mark will shortly be enclosed from the south ferry of Kincardine to the mouth of the Carron; thence again eastward, about 700 acres more to the entrance of the Avon; and from that point to Borrowstowness, perhaps another 600 acres. Indeed, operations on the first of these schemes would seem to have already been begun. It does not appear that they have received the sanction of the Admiralty, nor even that they have been submitted for the approval of that Board.

Now we are far from objecting to all embankments; on the contrary, enclosures carried out on a judicious line, and compensation given in depth of channel for the amount of surface tidal water excluded, may in some cases be beneficial to a river; all we contend for is, that such works should not be carried on at the pleasure of the adjoining landed proprietors without the consent of the Admiralty, or some Board competent to decide upon the damage or benefit to navigation likely to arise. Supposing that the depth at high water should average only 6 feet (a moderate estimate, where the tide rises 18 feet on springs) over the 2400 acres already embanked, or proposed to be embanked, there would be excluded in round numbers 24,000,000 cubic yards of water on every tide, or twice in the twenty-four hours. Can such a loss of scouring power be sustained with impunity in a river in which we have seen that in the best part of the channel there is barely sufficient water for a straitened navigation?

CHARLESTON.

CHARLESTON has an area of five acres in its old and new harbours, which are sheltered by piers from all winds but the south-east; more than 100,000 tons of coal are shipped here annually, besides lime and pig-iron. The arrivals were, 1467 vessels of 83,723 tons, and its revenue was 556*l*. during the past year.

ST. MARGARET'S HOPE.

ST. MARGARET'S HOPE offers a large expanse of good anchorage above Queen's Ferry, and a harbour of refuge to vessels caught in an easterly gale off the entrance of the Firth, or when riding heavily in Leith Roads, and a few hundred pounds expended in lights and beacons for the upper part of the Firth, including a light at Battery Point, would double its value by App. Ev. p. 3. rendering it available by night as well as by day, which at present it is not.

INVERKEITHING.

INVERKEITHING is a harbour within a harbour; the entrance into the outer bay is between piers 500 feet apart, and many vessels take shelter in it in easterly gales. The inner harbour has berthage for ships of from 12 to 13 feet draft at spring tides. See plan, p. 164. The arrivals and sailings in 1846 were, 864 vessels of 67,540 tons; of these, 289 vessels were to or from the colonies or foreign. The revenue was 352*l*., and the debt 2465*l*.

See plan, p. 164.

ST. DAVID'S has an area of 3 acres, enclosed by east and west piers, with an entrance of 205 feet, and a depth of 16 feet between them at spring tides; the inside is soft mud. The harbour has recently been improved, and warping buoys are laid down outside; 198 vessels of 20,414 tons, laden with coal, cleared out of this creek in 1846. It appears that no dues are levied.

At BRUCEHAVEN the arrivals and sailings were, 440 loaded vessels of 37,298 tons, and the revenue 15*l*. At Bridgeness, 396 vessels of 20,673 tons, and the revenue 92*l*. App. No. 491. These four harbours are creeks of the port of Bo'ness; and the first three named have a large foreign trade in coal. They were built respectively by the proprietors of the adjoining estates; and the dues, where levied, are so by "mutual consent."

ABERDOUR.

App. No. 91.

ABERDOUR is formed by a single pier on the west side of the mouth of the Dour burn, and has 12 feet water at spring tides. Besides its trade in limestone, 133 vessels of 9135 tons cleared with coal, chiefly for Sweden and Denmark, last year. The revenue, arising from dues levied under charter of 1704, was 110*l.*

STARLIE BURN.

STARLIE, or Stanley burn, is a very small harbour, principally used for shipping freestone from the adjoining quarries; it is enclosed by a south and a west pier; width of entrance 54 feet; depth 10 feet at springs. Fresh water is plentiful, and may be shipped with convenience.

Newbiggin, on the eastern side of Starlie Point, is a well sheltered small harbour, the property of the Carron Company, and whence they ship the limestone for the use of their furnaces; it is formed by a south pier projecting eastwards, and has a depth of 15 feet at spring tides; the bottom is silt over rock.

BURNTISLAND.

See plan, p. 164.

App. No. 92.

BURNTISLAND is the best harbour in the Firth of Forth, being easy of entrance under all circumstances, and having a good roadstead in front. It has an area of 20 acres, enclosed by piers, with an entrance 125 feet in width facing south-south-west; the depth between the pier-heads is 17 feet, and from 12 to 13 feet over the rest of the harbour, on a bottom of sand over clay. It can boast of a graving-dock 200 feet long, width of gates 44 feet, depth over silt 16½ feet; capable of receiving a ship of 1000 tons. There is a fixed bright light on the east pier, placed in the year 1800, and visible 8 miles. The arrivals last year were, 365 vessels of 14,114 tons; the dues levied by charter of King James V., granted in 1541, and confirmed by King Charles I., in 1632, amounted to 475*l.* in 1846; and the debt is 500*l.* Recently, an excellent slip, or pier, 170 yards long, has been carried out to the eastward of the harbour, into 9 feet depth at low water, or 27 feet at high water spring tides, whence steam-ferry communication is kept up at all times across the Firth to Granton, and thus forms the connecting link in the Edinburgh and Northern line of railway.

The Blae Rock, which lies a mile off shore, about midway between Burntisland and Kinghorness, and has only 17 feet depth over it at low-water spring tides, should, if possible, be buoyed.

PETTYCUR.

App. No. 94.

PETTYCUR is formed by a south-eastern pier, 123 yards long, with a sluicing reservoir at its inner end; there is a depth of from 12 to 13 feet alongside the pier at springs, over a bottom of mud, but the harbour has a considerable run into it in easterly gales. There is a tide light at the pier end. Its revenue, raised from dues levied by authority of the Corporation of Kinghorn, was 180*l.* in 1846. The harbour has recently been purchased by the Edinburgh and Northern Railway Company. Kinghorn pier is in ruins, and the harbour sanded up, and not used for any purpose; it has barely 6 feet depth at high water.

KIRKCALDY.

See plan, p. 164.

See section p. 668.

App. No. 96.

10 Geo. IV. c. 99.

KIRKCALDY has an area of four acres, including a half-tide basin, enclosed by piers; the outer entrance is 64 feet wide, with a depth of 14 feet between the pier heads; the entrance to the basin is 32 feet wide, and a depth of 6 feet water is retained in it by gates. There is a fixed light on the east pier. The extension of the east quay, 100 yards in 1843 4, has greatly quieted the violence of the sea in the harbour, at high water, in easterly gales; but to gain the whole benefit of the improvement, the engineer's plan should be fully carried out, and the west pier be rebuilt, an expenditure which the rapidly-increasing harbour revenue would seem to warrant. The arrivals in 1846 were, 646 vessels of 32 254 tons, of which 76 vessels were from the colonies or foreign; and the customs dues of the whole port, from St. Andrews on the east to Aberdour on the west, were 9097*l.* The harbour is managed by Commissioners under an Act of Parliament of 1829; the revenue last year was 2095*l.*, and the debt 8957*l.* A branch of the Northern Railway is now being led down to the harbour, and when completed, a ferry will be established across the Firth. Three whalers still sail out of the port.

DYSART.

See plan, p. 164.

43 Geo. III. c. 57.

DYSART has an area of three acres, sheltered by piers, with an entrance to the south-west 67 feet wide; depth 16 feet. Here is a patent slip for repairing vessels, and a small wet-dock with an entrance 38 feet wide; but the dock gates are out of order. About 30 yards of the east pier, washed down in a gale in November, 1843, have just been rebuilt, but in a wrong direction, according to the opinion of the only sailor on the Harbour Board. The arrivals for the past year were 152 sailing vessels of 5085 tons, besides 900 calls from steamers. The harbour is governed by the managers of the burgh, and the dues, levied under an Act of 1803, were 249*l.*

WEST WEMYSS.

WEST WEMYSS is an acre and a quarter in extent, and is sheltered by a circular east pier, with a sluicing basin at its upper end. The inner side of the pier is kept well dredged out, and vessels of from 9 to 10 feet draft can lie afloat at low water; the bottom is sand over soft sandstone. The shore dries for 80 yards outside the pier-head, and there is a depth of 15 feet at spring tide over the bar. Considerable range is thrown into the harbour during easterly gales. The arrivals in 1846 were 536 vessels of 38,610 tons, 11 of which were from foreign, and the dues, levied by "mutual consent," amounted to 102*l.*

BUCKHAVEN.

Fishery Rep. 1836.

BUCKHAVEN, a well-known fishing station, with 125 boats, employing 625 men and boys, has an area of about three acres, sheltered by a circular east pier, and a detached breakwater to the westward, with an entrance between 58 feet wide; the depth in the harbour is from 9 to 10 feet over rock. The harbour was built in 1836-40 at an expense of 6057*l.*, three-fourths of which were contributed by the Fishery Board. No dues are levied. In south-west gales there is a heavy range in the harbour. Arrivals last year 23 vessels of 1230 tons.

SCOTLAND.

METHILL.

METHILL is about four acres in extent, enclosed by piers with an entrance 80 feet wide, and a depth of 16 feet at the pier heads at spring tides. In the great storm of 1803 a large portion of the east pier was swept down by the waves, and for many years almost choked up the harbour; the west pier also suffered. In 1805 Parliament granted 2000*l.* in aid of repairs, which sum, with the addition of 942*l.* paid by the late proprietor, was laid out on the works of the west pier. In 1839 the east pier was rebuilt at an expense of 5000*l.* by the present proprietor, Captain Erskine Wemyss, R.N. The arrivals in 1846 were 190 vessels of 9399 tons; the revenue 107*l.* Easterly gales throw in a heavy swell: to remedy it in some measure, the plan of placing piles to break the force of the waves has been here tried and with some success.

See plan, p. 164.

App. No. 101.

LEVEN.

LEVEN is a small river harbour, with 12 feet over the bar at high-water springs: a better depth in the channel through a long sandy flat up to the town has been gained by the employment of sheet piling. South-easterly gales send home a heavy sea. The arrivals last year were 234 vessels of 9684 tons; the dues levied by authority of the proprietor, 313*l.*

App. No. 102.

LARGO.

LARGO, at the mouth of the Keil burn, has a pier to the eastward, and to the westward a natural ledge of rock, called the Pier of Lundin; width of entrance 56 feet. There are about four berths within the elbow of the east pier for vessels drawing 9 or 10 feet, on a bottom of clay. The arrivals in 1846 were 60 vessels, and the revenue 40*l.*

App. No. 491.

ELIE.

ELIE enjoys the reputation of being, after Burntisland, the best harbour in the Firth of Forth, and is the one most often taken by shipping. From its naturally sheltered position, it has long been known as a secure harbour in easterly gales, and as having afforded refuge to many a fishing boat in distress. The peninsular rocky point, which projects at the southeastern point of the bay, is well adapted for a landing place for steamers, on either side, according to the state of the wind; but it seems that there are no funds even for the small outlay such a work would require, or for raising the sea-wall or dyke, that connects the pier with the town, which is very requisite, or the harbour will be filled with sand from Wade's Bay. It was even with difficulty a sufficient sum was raised to repair the small pier, 70 feet of which were washed down by the sea some years since, and long lay in that state. It is lamentable to see a good natural harbour, that might at a small expense be rendered of great value to sailors and the public, lying comparatively useless from the indifference or neglect of those whose duty as well as interest it is to look after it, and keep it in repair. The arrivals and sailings in cargo last year were, 168 vessels of 6903 tons.

See plan, p. 164.

App. No. 103.

THE VOWS.

Immediately off shore to the westward lie the dangerous half tide rocks, called THE VOWS, right in the track of the numerous steamers that call at Elie in the summer time, and of vessels that run to this harbour for shelter. The wrecks of the *Wanderer*, the *Benledi*, and of fishing boats, sufficiently attest the danger, yet no beacon marks the spot, and it is alleged that a petition, praying the Commissioners of Northern Lights to erect such a beacon, remains unattended to.*

App. No. 104.

Another cause of complaint is, that sunken vessels are allowed to remain in the fair-way without a buoy being placed on them, or any attempt being made to remove them. A sloop, sunk off St. Monance, was long an annoyance to the fishermen of that place, as the mast caught their nets and destroyed them, until, at their earnest remonstrance, it was towed away by H.M.S. *Cuckoo*. Another wreck recently reported to the Admiralty has lain for six months, and still lies, we believe, within a mile of Fifeness, the mast-head just on a level with the water, ready to stave any fishing boat or vessel, or destroy her nets. On the coasts of England such wrecks would be immediately buoyed or removed by the Trinity Board; and if a similar duty does not devolve on the Board of Northern Lights, the safety of vessels and of sailors' lives demands that some proper authority to remove such obstructions should be constituted.

Fishery Report, 1846.

ST. MONANCE.

ST. MONANCE is a small fishing harbour, formed by a single south-eastern pier, with a depth of from 10 to 12 feet within at high water; it has 85 boats. PITTENWEEM has a small inner harbour or basin defended by booms, and an outer harbour, formed by an old or eastern, and a middle pier (the latter repaired and rebuilt in 1822); the entrance to the outer harbour is 75 feet wide; to the basin 26 feet, with a depth within of from 12 to 13 feet. The arrivals in 1846 were 38 loaded vessels of 1363 tons. The dues levied by the burgh under a charter of King James IV., granted in 1547, amount to 43*l.* Here are 47 herring boats.

App. N

ANSTRUTHER.

ANSTRUTHER is, after Elie, the best harbour on the north side of the Firth below Burntisland. It has an area of six acres, enclosed by north and south piers, with an entrance between, 111 feet wide, facing south-west; the harbour is shallow, having only 10 feet depth alongside the pier; the bottom is sand and silt over rock. There is considerable range in the harbour in easterly gales, and it is proposed to extend the south pier in order to remedy the evil. Anstruther is a sub-port of Kirkcaldy, and has 66 vessels of 3098 tons belonging to it. The arrivals in 1846 were 202 vessels, of 9715 tons; the revenue from dues levied by authority of the Town Council, 179*l.*

See plan, p. 164.

App. No. 108.

CELLARDYKE.

CELLARDYKE, a fishery harbour, has an area of 1½ acres, sheltered by a south-east pier and a western spur; entrance 72 feet wide. It was improved by the extension of the east pier in 1830 at the joint expense of the Fishery Board and the fishermen; but so little protection is still afforded within it, that directly the wind comes to the south-eastward, or on shore, the fishermen are forced to shift their boats from it, at a great risk, to Anstruther or to Elie. By

See section, p. 712.

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* A beacon is now in the course of erection.

SCOTLAND.

See plan, p. 164.

App. No. 497.

narrowing the entrance, and extending the east pier to the point of the rocks, it is probable that the run of the sea might be materially lessened; but a beach for the swell to expend itself upon is the great want of the place. At Craignoon, a little to the westward, there is a fevourable site for a harbour, and by taking proper advantage of the Sandling Rock, good shelter might be obtained. In 1838, Mr. Leslie, C.E., made a plan for a limited harbour at this spot, at an estimate of 5800*l.*, but nothing has been done. Here are 102 herring-boats, employing 510 men and boys.

CRAIL.

See plan, p. 164.

App. No. 110.

CRAIL harbour, three-quarters of an acre in extent, is enclosed by a south pier and a western spur; entrance 25 feet wide. From lying within ledges of rock, and having an extensive foreshore of sand, it is difficult of access, but has depth for a few vessels of 12 feet draft. The arrivals in 1846 were 65 loaded vessels of 2320 tons, and the revenue from dues levied by charter, was 79*l.* It having been represented to the corporation that Rome Bay, a little to the eastward of Crail, was a good site for a harbour of refuge, they with much public spirit engaged a competent engineer to make a detailed survey of the bay and its vicinity: his report and a plan will be found in the Appendix.

Fishery Report, 1846.

The want of such a low-water harbour, or rather the necessity for deepening all the small harbours along this coast, will be manifest, from the fact that in the event of a sudden gale occurring, there is not, along the whole coast from Fifeness to Queensferry, a harbour that can be entered even by a boat at low water, while the fishing boats alone belonging to this district are 420 boats, with 2000 men and boys. The catch of herrings in the Forth during the past year amounted to 97,000 barrels; the fishing, therefore, would seem to be a branch of native industry deserving of every encouragement, and it would be difficult to point out a more legitimate or beneficial mode of affording such encouragement than by the improvement of all these small harbours. The Fishery Board have been enabled to do some good, and wherever they have improved a harbour, a more than corresponding improvement has taken place in the fishery; but their means are extremely limited—only 2500*l.* a-year to be laid out on all the harbours of Scotland is far too small a sum to do any substantial good; four times the amount at least for a very few years would yield a far better return in proportion; and, considering how rapidly railroads are competing with our coasting trade, and thus interfering with our best nursery for seamen, it would seem good policy that every effort should be made to encourage to the utmost the resource held out by our fisheries.

TIME-BALL.

App. No. 23.

Before quitting the Firth of Forth, it is necessary to notice, that a strong representation having been made to the Admiralty, as to the desirableness of exhibiting a time-ball on the Calton Hill, or at some other conspicuous place, to enable the masters of vessels to ascertain the error and rate of their chronometers, an investigation was directed, whence it results, that Nelson's Monument on Calton Hill would combine every requisite, in point of position, for such an object; that a connexion between it and the Transit Room of the Observatory could readily be established, either by electric telegraph or otherwise; that the Lord Provost and Town Council of the City of Edinburgh would cheerfully sanction such use of the column, and that the cost of erecting the necessary apparatus would not exceed 200*l.* It was also ascertained that the number of chronometers sent to the makers to be rated, by ships sailing from the Firth of Forth, was not less than 120 in 1845, and last year it was expected they would reach 150; this number is exclusive of those rated at Alloa or Grangemouth; of those carried by vessels that occasionally anchor in Leith Roads, whether calling for orders or driven in by stress of weather; of French vessels of war protecting their fisheries, and of all Her Majesty's ships. It thus appears that, independent of the general advantage to the public, the exhibition of a time-ball at Edinburgh to show correct Greenwich time would be of immediate practical utility to a very much larger number of vessels than any former accounts had led us to anticipate, and would be hailed by all interested in the foreign trade of the country as a very great boon.

ST. ANDREWS.

See plan, p. 268.

App. No. 114.

ST. ANDREWS, lying at the bottom of a deep bay, is exactly in the position in which a good harbour would be of much service to vessels embayed in an easterly gale between the projecting headland of Fifeness and the Tay Sands; even the extension of its pier to low water, and the removal of the rocks called the Burn Stools, which might be done at a small expense, would confer great local benefit. An immediate stop, also, should be put to the carrying away the sand from the beach, from which great mischief is likely to arise. The arrivals, in 1846, were 155 vessels, of 6025 tons, and the revenue, arising from dues levied by authority of the magistrates, 180*l.* The minutes of the Town Council, which give the history of the harbour for about three centuries, show that it has always attracted much attention, but it does not appear that any well-considered plan of improvement by a competent person had been ever laid down and steadily acted upon, possibly from want of funds.

RIVER EDEN.

At Guard Bridge is a fixed bridge across the mouth of the river EDEN, that might, without difficulty, be made navigable for some distance towards Cupar, which is 9 miles from the sea. The tide, which rises 15 feet on the coast, reaches Lydox Mill, 3 miles above Guard Bridge, where it is stopped by a dyke or weir across the river. There is a quay just below the bridge at which timber and coal are landed for the neighbouring district.

RIVER TAY.

See plan, p. 268.

The RIVER TAY is the largest of all the Scottish streams; its extreme length, including its windings, is about 180 miles; it drains an area of 2300 square miles, and is said to pour more water into the ocean than any other river of Great Britain. It is navigable for the largest ships to Dundee, and, at tide time, for vessels of 14 feet draft to Newburgh and to Perth, a distance of 29 miles from its entrance.

In the mean state of the Tay, its discharge opposite Perth, as measured by the late Dr. Anderson, is at the rate of 3640 cubic feet per second; but in the summers of 1819 and 1835, it was reduced to 457 cubic feet, or less. The discharge of the Earn, which falls into the Tay, is 916 cubic feet per second, and that of the united stream 4556 cubic feet per second. The Tay also is subject to heavy floods, as in the years 1796 and 1814, when a vessel was laid on the quay at Perth, and in December, 1845. The river, it is said, has risen occasionally from 10 to 12 feet in twenty-four hours. On a full average flood on the 12th November, 1844, the discharge of the Tay, as measured by Mr. Leslie, was 12,562 cubic feet per second; of the Earn, 3593 cubic feet; and the united discharge, 16,155 cubic feet per second. An extreme flood would be 4 feet higher. But the great value of the Tay to commerce is as a tidal river; the rise of 15 feet at Dundee, 13 feet at Newburgh, and 10 feet at Perth, is an invaluable boon if properly taken advantage of; such, however, is far from being the case at present, as will be manifest by the fact that the velocity of the tide wave (that is, of the successive times of high water), from Dundee to Balmerino, is 18½ miles an hour; from Balmerino to Balmbreich, 5½ miles; from Balmbreich to Carpow, 3½ miles; from Carpow to Perth, 6 miles. Now there is no surer test of the state of a river than the velocity of the tide wave; and it is clear from the above that the chief obstruction to the tide takes place between Balmbreich and Carpow, just at the top of Mugdrum Island, at the very spot at which it was proposed to place the additional obstruction of a railway viaduct.

App. No. 124.

App. No. 149.

App. No. 127.

At Ferry Port-on-Craig, the first creek within the Tay on the south side, there are two piers, a passage pier and a loading quay. The arrivals in 1846 were, 159 vessels of 8121 tons, and the dues levied by charter, 53*l.* A low-water pier is about to be constructed here for the use of the steam-ferry across the Tay, in connexion with the Edinburgh and Northern line of railway. There is an extensive salmon fishery along this shore, and here, as well as in other parts of the Tay, fishing dykes and cairns, almost out to low-water mark, appear to have been erected at the pleasure of the salmon fishers.

Ferry-Port-on-Craig.

App. No. 117.

App. No. 143.

A quarter of a mile to the westward are the Port-on-Craig leading lights, respectively 45 and 65 feet above high water, which on a very clear night may be seen 10 miles. For leading up the Tay it is necessary that they should be visible only 7 miles, but it is doubtful whether, in the usual state of the atmosphere, they are sufficiently brilliant to be readily distinguished so far. By day, too, owing to vessels being aground, and others at anchor off the place, it is often difficult to make the lighthouses out so as to keep them steadily in one while running up the river.

At Newport is a slip or pier for the steam-ferry across the river to Craig Pier at Dundee. These two piers were built between the years 1823 and 1826, at a cost of 22,000*l.*, from plans by Telford. Doubtless there was some sufficient reason for placing the ferry here, but this is far from being the shortest or most direct crossing of the Tay; and indeed at times it is very circuitous, being round the end of the Middle Sand. There is little depth to spare at Newport Pier, and still less in Craig Harbour, where it seems the ferry-boat not uncommonly grounds at low-water spring tides.

Newport.

App. No. 156.

There is a private pier at Newport, as well as at Woodhaven and Balmerino, and at Kingoodie on the north shore, at which the dues were respectively 5*l.*, 7*l.*, 8*l.*, and 30*l.* in 1846.

Newburgh was much used as a stopping place prior to the deepening of the river above. There is a long river quay with several jetties, and considerable ship-building is carried on. The arrivals in 1846 were, 114 vessels in cargo of 7737 tons, and the dues, including West Newburgh, were 129*l.*, levied by "mutual consent."

Newburgh.

The Earn is navigable for small craft up to the bridge of Earn, at 6 miles from the Tay; were it considered an object, the river could without difficulty be made navigable into the valley of Strathearn. At Elcho Castle and Friarton on the west side of the Tay, and at Kinfauns, Inchyra, Pitfour, Cairnie, Errol and Powgavie on the north side, there are small private piers or landing places for the accommodation of the surrounding districts.

Perth.—Prior to the year 1830, the affairs of the port and harbour of Perth, and the interests of the navigation of the Tay, were, by charter, in the hands of the magistrates of the city, who do not seem to have been well aware of the value of the noble river entrusted to their charge. The upper portion of the Tay, as far as navigation was concerned, appears to have been quite neglected. Landed property on either side of the river, and the right of salmon fishing, were paramount, apparently, to every other interest; jetties or dykes, in order to form new ground, were run out at pleasure of the landlords, although with certain injury to the navigation of the river; and large heaps of stones, called fishing cairns, were erected at will in the bed of the stream. Similar indifference, with far less excuse, prevailed in the lower portion of the river, as only a single fairway-buoy was placed to mark the entrance and channel between two dangerous sands where now ten buoys are not found too many.

Perth.

App. Ev. p. 173.

Admiralty Chart, 1833.

The Perth Harbour Commissioners, appointed in 1830, after three years' consideration, became alive to the mischief that was daily accruing; they called in a competent engineer, caused a detailed and admirable survey of their river to be made, as far as Newburgh, and immediately on the receipt of Messrs. Stevenson's Report, obtained an Act to empower them to raise money for the improvement of the Tay. During the next few years, the process of deepening the bed, and of straightening the channel of the river, was steadily continued, and by thus affording a free passage to the tidal waters, a depth of 15 feet at high-water spring tides has been attained near the city, and the flood-tide now begins to flow three-quarters of an hour earlier than formerly at Perth Bridge.

4 Will. IV. c. 67.

App. Ev. p. 174.

SCOTLAND.

App. Ev. p. 175.

The arrivals at the port during the past year were, 1413 vessels of 72,443 tons; of these, 48 vessels of 4016 tons were from the colonies or foreign, and the gross receipt of customs duty, which in 1830 was only 3000*l*., is now 19,954*l*. These are gratifying results; but the increase of shipping brings with it a want of berthage, which is now much felt; not a day should be lost in extending the tidal basin, were it only 100 yards at a time; the Middle Bank, and the shelf off Friarton should be removed; the dredging-machine should be set to work off Elcho, Inchyra, and Mugdrum, and the requisite buoys and beacons be placed.

See plan, p. 268. App. Ev. p. 174. 2 Vict. c. 21.

The area of the tidal basin at Perth is about 2½ acres, and the length of the quays, including the river side, 650 yards; they are partly of stone and partly of timber, the latter much out of repair. There are 2 cranes; 12 building-slips, employing about 100 shipwrights; 2 foundries; a dredging-machine of 12-horse power, and 2 steam-tugs, besides the river steamers daily to Dundee. The tonnage belonging to the port, including the creek of Newburgh, consists of 89 vessels of 8728 tons. The harbour revenue for 1846 was 4506*l*., one-twelfth part of which is still paid to the City of Perth, in lieu of their ancient rights to levy dues under their charters. The expense of the Acts of Parliament, for improving the navigation of the Tay and therefore for a public benefit, has been 4673*l*. The whole sum laid out on improvements is 61,918*l*., and the debt 44,315*l*. The Commissioners are 30 in number, of whom 14 are of the Town Council and six burgesses of the City; the Act requires that there need be only three ship-owners, and no sailors.

App. No. 127.

One great impediment to improvement in the river has been caused by the proprietors of the salmon fisheries, all of whom claimed compensation for supposed injury. Another expense of about 3000*l*., unjustly thrown on the harbour funds, has been occasioned by boldly contending for the rights of the public in opposing the erection of a bridge over the Tay at Mugdrum; and it is highly creditable to the Perth Commissioners that they thus so firmly resisted the several attempts of a railway company to place a viaduct across one of the noblest navigable rivers in the United Kingdom.

DUNDEE.

Situate on the north bank of the estuary of the Tay—so far a deep navigable river at all times of tide—in the midst of a fertile and populous country, the seat of extensive manufactures, holding a favourable position with respect to the Baltic, whence the chief part of its raw material is obtained, DUNDEE has great natural advantages for an extensive coasting and foreign traffic, which have been well seconded by the energy of her merchants and shipowners.

This port offers an instructive example of what may be accomplished by the persevering efforts of a few persons whose minds are steadily directed to carrying into effect a comprehensive and well-considered plan of harbour improvement; and at the same time holds out a warning that the best intentions of a large body of indifferent persons acting on no fixed plan are likely to result in failure.

App. Ev. p. 194. App. No. 136. 55 Geo. III. c. 97.

Prior to the year 1815, the management of the harbour was vested by charter in the magistrates and Town Council, and the dues from shipping were applied to the same purposes as the town revenue; while in the ten years previous, although 14,000*l*. had been collected as shipping dues, only 1200*l*. had been expended on the harbour and wharfs. It was, however, discovered that the prosperity of the port was connected with that of the district at large; the harbour accommodation was felt by all parties to be insufficient; and as the corporation would only propose a limited plan of improvement, quite inadequate to the increasing traffic, a number of public-spirited individuals, merchants, shipowners, and others interested, interposed, and Telford's plan, and the Act of 1815, appointing 21 harbour trustees, to be annually elected, were the result.

See plan, p. 268. App. Ev. p. 194. Customs dues, 1846.

Under this special management nearly the whole space between high and low-water mark, from Carolina Port on the east to Craig Harbour on the west, has been enclosed by a river wall; two spacious wet-docks, containing an area of 11¼ acres, capable of accommodating 23,000 tons of shipping, have been completed and are in full activity; and the tidal harbour has been deepened and extended to 4¾ acres. Another wet-dock of 14½ acres, opening from a tidal harbour of 11 acres, is far advanced towards completion; besides a graving-dock, a patent slip, powerful cranes (one capable of lifting 30 tons), sheds, building-slips, and every requisite for a first-class port. On these improvements 400,000*l*. have been expended, of which amount the sum of 221,234*l*. remains as a debt at 3½ and 4 per cent. rate of interest. The revenue, which at the commencement in 1815 was 4096*l*., is now 25,000*l*., while the arrivals last year were 5031 vessels of 378,345 tons; of these, 409 vessels were from the British colonies or foreign, and the customs duty amounted to 57,028*l*.

See plan, p. 268. App. Ev. p. 197. App. No. 141. App. Ev. p. 196. App. No. 158.

Hitherto all has been prosperous, and we trust will continue to be so for years to come, but it is not difficult to foresee that it will require great vigilance on the part of the trustees, and some decisive steps to be taken, to prevent the foot of the quays and the entrance to the tidal basin from silting up. In addition to the serious impediment they offer to navigation, the Fowler, Beacon, and Drummond rocks (just to the eastward of the entrance), by causing an eddy on the flood-tide, occasion a deposit at the harbour's mouth, and a slight concavity in the face of the river-wall tends to lead the silt into the basin; while at the same time to the westward of the harbour the Ballast Bank is gradually increasing. The most obvious mode of arresting these evils would seem to be to quarry or blast the rocks entirely away, to cut off the point at Magdalen Yard, and to run a wall in a slight curve from that point to the Craig Pier, in order to guide the ebb stream in its strength along the face of the quay. It further appeared in evidence, that the want of a low-water pier is much felt, and causes great inconvenience and detention; that the pilots are far from efficient, chiefly owing to the payment of pilotage not being compulsory; that the shore dues are very high, and that part of the harbour funds have recently been laid out for other than harbour purposes.

In the upper part of the river Tay, near Powgavie, seven miles higher up on the north shore,

SCOTLAND.

attempts at embankment have been made by running out dykes, and one of these extends to 1000 yards below high water; should this project be completed, about 1800 acres of the alveus, or bed of the river, over which the tide flows twice in the twenty-four hours, would become dry land, and a large amount of tidal scour be lost. The trustees of the harbour of Dundee have very properly remonstrated against this proceeding, as well as against a more recent attempt to narrow the gorge of the river, by a railway pier at Broughty Ferry; but the assistance of Government is necessary in order effectually to put a stop to similar encroachments.

App. No. 149.

App. No. 146.

It was stated in the First Report of this commission, that when examined in 1844, the Gaa Sand at the mouth of the river had within the last ten years been materially reduced; another examination, made a year later, has fully confirmed that change, and shows a further decrease of the sand, so that vessels may now run boldly into the river with the Craig Lights in one, having 15 feet at low water, where in 1833 there was only a depth of 3 feet. In the absence of any other known cause it does not seem unreasonable to attribute this change to the scour caused by the increased volume of tidal water, admitted in consequence of the river having been deepened at the several fords and shallows by the dredging operations between Newburgh and Perth; and such success and improvement to the navigation hold out great encouragement to persevere in deepening throughout the upper part of the Tay, as well as all the channels of all our tidal rivers.

Admiralty Chart, 1846.

The complete state of the buoying of the entrance to the Tay is very creditable to the Seaman's Fraternity of Dundee, under whose management it is placed, and the fairway buoy is the tallest and most conspicuous on the coast of Scotland; nine other buoys mark the edge of the sands on either side. Two leading lights at Buddonness lead into, and the two Craig lights lead up, the river; these latter might be much improved. The revenue of the Fraternity, from lights, &c., is 1842*l.* Many opinions have been given as to the want of a floating light at the Elbow Buoy of the Abertay Sand, but no fact, that we are aware of, has yet been brought forward to prove the necessity for it. The real want is a good system of pilotage and efficient well-paid pilots, and these the traffic of Dundee and of Perth has a right to demand, and can well afford to support.

App. Ev. p. 197-8

App. Ev. p. 196.

The Tay is susceptible of much further improvement; the simple fact of the level of the river opposite Dundee being from 6 to 8½ inches lower than the level of the sea outside the sands, and of the average depression between Broughty and Newburgh, higher up the river, being from 12 to 15 inches below the same level, proves that a throttling of the tide takes place somewhere below Dundee; and this point is either at Broughty, or more probably at the Horse-shoe shoal, where the sectional area of the river at low water is the least: the Middle bank and the Ballast bank also will require to be carefully watched. In the upper portion of the river, we find that the slope of the bed is still 5 inches a-mile from Perth to Balmhreich, and 10 inches a-mile from Newburgh downwards; this fall should be equalized, and by continuing a judicious and well-considered system of marginal embankments, cutting off the deep bends of the river, removing fords, boulder stones, and above all, by freely using the dredging-machine, there seems no reason why a depth of from 18 to 20 feet at high-water spring tides should not be made and maintained both to Newburgh and to Perth.

App. No. 148.

App. Ev. p. 174.

App. No. 127.

At **BROUGHTY FERRY** there is a small timber jetty, but otherwise no landing accommodation, and the inhabitants complain of being obliged to pay the same shore dues as at Dundee on cargoes landed there. The mooring-posts placed by the Dundee trustees have been torn up and were lying on the beach, and attempts at encroachment have been made on the estuary. The assent of the Admiralty has been given to the erection of a low-water pier by the Edinburgh and Northern Railway Company, just to the westward of Broughty Castle, on condition that it shall not project into the river beyond a line joining high-water mark at Broughty Castle with the outer extremity of the timber jetty. At Monifieth and Carnoustie, vessels land cargoes on the beach in fine weather. The creeks of East and West Haven are used as district harbours, the latter has a pier at which coal and lime are landed for the extensive estate of Panmure. There are eight fishing-boats at either of these two Havens, and 16 boats at Broughty Ferry.

BROUGHTY FERRY.

App. No. 152.

App. Ev. p. 196.

App. No. 117.

App. No. 494.

At **ARBROATH**, as at Perth and Dundee, public feeling at length became alive to the impolicy as well as the injustice of applying dues, levied on shipping and on goods borne by shipping, to municipal purposes; and an Act of Parliament, in 1839, having appointed 19 trustees, and empowered them to raise money, a sum of 58,000*l.* has been since that time expended in enlarging and improving the harbour, in constructing a sea wall, a new outer harbour, and other works, whereby the accommodation for the shipping and trade of the port has been more than doubled.

ARBROATH.

2 Vic. c. 16.

The old harbour was built about the year 1725, and at that time the shore dues amounted to 25*l.*, and the only trade consisted of a few small coasters. The revenue for 1846 was 3333*l.*; the arrivals were 731 loaded vessels, of which 52 were from the colonies and foreign; the aggregate tonnage was 46,080 tons, and the customs duty amounted to 6572*l.* The whole area of the old and new harbours is six acres; the outer entrance is 100 feet wide, and there is a depth of 12 feet at the pier heads at high-water spring tides; the entrance to the inner harbour is 27 feet wide, and it can be secured by booms; there is a patent slip, proved for 200 tons, and the extent of wharfage is 800 yards. There are 20 pilots belonging to the port, and a red tidal light on the east pier head. A good perch or buoy is required on the Cheek Bush, a dangerous rock off the entrance of the harbour. The piers are founded on rock, so that they will admit of the harbour being dredged; the outer, or sea wall, is of red sandstone rubble, faced with ashlar, and very substantially built, and hitherto has firmly withstood the heavy sea to which it is exposed.

App. Ev. p. 244.

See plan, p. 268.

See section, p. 712.

The plans for improvement, as designed by Mr. Leslie, C.E., are far from completely carried out; the intention was to convert the old harbour into a floating basin, to remove the old piers,

SCOTLAND.

App. Ev. p. 244. and to deepen the entrance; this last measure is of the utmost importance, and should be accomplished at almost any sacrifice; it would be necessary to clear a channel 100 feet wide and 3 feet deep, for a length of 230 yards, to low-water mark; the soil is soft sandstone, with numerous boulder stones, many of which might be lifted without much difficulty; the estimate is 10,000*l.*, and this outlay would double the value and doubtless greatly increase the traffic of the port. But the trustees, it appears, have exhausted their resources, and incurred a debt of 53,985*l.*, and after all their exertions, from want of a little timely assistance, much of what has already been done will be in a great measure unavailable; and the opportunity of securing a good harbour on a part of the coast where it is much needed will be lost to the public.

First Report, p. viii. The Commissioners, in their First Report, in 1845, called particular attention to the public spirit of the inhabitants of the town and neighbourhood of Arbroath, to the importance of the harbour on that part of the coast, and to the efforts made by them to bring their harbour into its present state. The additional works that are necessary to make it more useful as a tidal refuge harbour for coasting-vessels of the usual size that navigate that dangerous coast were pointed out in the Evidence, as well as that the large expenditure of 58,000*l.* on the harbour had exhausted the means of the Trustees, and that the assistance of Government was needed to enable them to complete it. The works already executed are substantial and good; and I entirely concur in the recommendation of the Commission in their First Report, that if assistance shall be given to improve any harbour, the harbour of Arbroath, under all the circumstances stated, is specially deserving the aid of the public in order to enable the trustees to deepen its entrance and approaches as pointed out before this Commission.

BELL ROCK.

At 9½ miles to the south-east of Arbroath lies that once formidable danger, now the mariner's best friend, the BELL ROCK, a mass of red sandstone, dry at low water for 500 yards, in a north-east and south-west direction, rising abruptly from the sea, with deep water all around it, and a depth of 20 fathoms between it and the nearest part of the coast. The lighthouse erected upon it was begun on the 17th of August, 1807. the foundation stone laid on the 10th of July, 1808, and the light exhibited on the 1st of February, 1811; its whole height is 115 feet, diameter of base 42 feet, of light room 13 feet; and the foundations are laid on a level with low water of ordinary spring tides. Cost 61,331*l.* The light is placed at 90 feet above the sea; it revolves, and shows alternately bright and red, and is visible 14 miles in clear weather. In foggy weather a bell is sounded every half minute. As many as 19,095 vessels, carrying cargo, paid dues, as passing this light during the last year; the toll, which was formerly a penny, was reduced to a halfpenny, per ton in 1846. The plan of operations, and the steady perseverance with which this difficult task was accomplished, do great credit to Mr. Robert Stevenson, of Edinburgh, at that time engineer to the Board of Northern Lights.

Lighthouse Report, 1846.

MONTROSE.

MONTROSE harbour is formed by the outlet of the South Esk, which falls into the sea between the rocky point of Scurdy Ness on the south, and the Annat Sand, which forms a natural breakwater on the north, leaving a channel between 170 yards wide, with a depth of 18 feet at high-water springs, and 15 feet at neaps, up to abreast the town quays.

App. Ev. p. 253. Prior to 1837 the harbour was, by charter, governed by the town council; but in that year an Act was obtained appointing twenty-two trustees, and giving power to raise 40,000*l.* Finding that the depth at the quays and the extent of wharfage were not sufficient for the increasing traffic, a wet-dock of 3½ acres in extent was designed by, and carried out under the superintendence of, Mr. J. Leslie, C.E., with the entrance 55 feet wide, and a depth of 19½ feet over the sill at springs, and 16 feet at neap tides; its value has recently been proved by a large war-steamer having entered it at neap tides to take in coal, which, with the exception of the west dock at Dundee, could not at present be done at any other port in Scotland.

App. Ev. p. 254. The arrivals, during the past year, were 914 vessels of 62,058 tons; of these, 71 vessels were from foreign, and the customs duty amounted to 26,153*l.* The tonnage belonging to the port was 118 vessels of 14,988 tons. The dock and town quays afford 100 yards of wharfage. There is a patent slip, and about 100 shipwrights belonging to the port employed in ship-building. There are 20 licensed pilots, two good leading lights erected by the shipowners of the port, and a well-found life-boat. The revenue in 1846 was 4399*l.*, and the debt 45,922*l.*

App. Ev. p. 254. It appeared in evidence that the "Leads" and "Stone," dangerous rocks lying off Scurdy Ness, just at the entrance of the harbour on the south side, have no beacon to mark them: either a beacon should be at once erected on the "Stone" or it should be blasted away. The want of a conspicuous perch on this rock (which is steep to, and gives no warning by the lead) makes vessels afraid of hugging Scurdy Ness, and thus they get thrown to the northward, and wrecked on the Annat Sand. It appeared, also, that the Crossdyke, a ledge crossing the river a little below the lower lighthouse, with only six feet on it at low water, should be deepened; that the channel thence to the Stell required to be dredged; that the quays were far from being in a good state of repair; that measures should be taken to fix a shingle bank, called the "Scalp," on the south side of the channel, and that a tug-steamer is much needed, and would be very useful for the traffic of the port.

See plan, p. 268. A suspension-bridge across the river to Rossie Island, at the entrance of the basin, stops the navigation for everything except boats, but vessels of eight feet draft can pass in by a drawbridge across the south channel, and, at tide time, sail up about 2 miles to Old Montrose, where formerly a considerable trade in lime was carried on. Were there a sufficient object, an inland navigation might be formed from Montrose to Brechin, 7 miles up the South Esk river. Off Ferryden, a fishing village on the south side, there is a depth of 16 feet at low-spring tides; here is an extensive and productive fishery, employing 44 boats and 204 men, who (besides the salmon and herring fishery in the proper season) follow the far more useful and more lucrative employment of line fishing all the year round.

The great feature at Montrose is the large tidal basin, or slake, an estuary of about 1200 acres, immediately to the westward of the town, which is covered with water on every tide; in fact, it is the channel connecting this salt-water lake with the sea, which constitutes the harbour of Montrose, and which is kept deep by the quantity of water running through it during the flux and reflux of every tide; it is hardly necessary, then, to say that it is essential that this reservoir be preserved entire. Such, however, has not been the case: it appears in evidence that the proprietors of the land adjoining the South Esk near Old Montrose, in 1817 and in 1831, made embankments at the head of the basin, and the most recent encroachment consists of 62 acres, embanked in 1841 by the present proprietor, which, by the Report of the Admiralty engineer sent to inspect it, excludes 10½ million cubic feet of water on every spring tide. The Montrose trustees very properly commenced a suit at the Court at Edinburgh against the embankment, but having recently expended the large sum of 42,000*l.* in constructing a wet-dock, and improving their harbour, they have not the means of contesting with a wealthy proprietor the point at issue, and, therefore, naturally look to the Admiralty for protection. As to the legal doctrine which it is understood has been propounded by the law officer of the Crown for Scotland, that it is necessary to wait and see the damage caused before taking any steps to prevent it, it is almost incredible that such should have been given; or, if such doctrine is to be admitted as law, there is at once an end to all conservancy of the harbours of the United Kingdom.

See plan, p. 268.
App. Ev. p 253.
App. No. 176.

GOURDON.

At GOURDON is a small harbour, well sheltered by an eastern pier (erected at a cost of 2000*l.*, half of which was contributed by Government), and a detached breakwater more recently built; the entrance is narrow and crooked, but marked out by beacons. The arrivals last year were 77 vessels of 3638 tons, and the dues, levied by Act of Parliament, 224*l.* Much grain is shipped here, and it is the haven of 27 fishing-boats, with 82 men. At UZON is a safe creek between the ledges of the rocks, in which a landing may often be effected when it cannot be made elsewhere on the coast: here are 11 fishing-boats. At SEAGREEN is a small pier built for shipping lime, no longer used. At JOHNSHAVEN is an inlet protected by high-water rocks, at which much corn is shipped; the dues, levied by the proprietor under a charter, were 113*l.* in 1846.

4 Vict. c. 49.
App. No. 179.

STONEHAVEN.

STONEHAVEN, well sheltered to the southward by Downie Point, has an area of about five acres, enclosed by piers, with a depth of 15 feet at high-water springs at the pier head; two inner jetties form the southern portion into an inner harbour, with an entrance 50 feet wide, and having 12 feet alongside the quays. There are leading lights on the north pier head. The arrivals last year were 118 vessels of 5981 tons, and the revenue 539*l.* The whole outlay on the works has been 9000*l.*, and the present debt is 10,896*l.* This harbour, although small, has some natural advantages, which makes it of value to the coasting trade, and particularly as affording refuge at tide time in the bight of a bay, from which, in an easterly gale, it would be difficult to escape. Stonehaven is the chief station of a fishery district, 55 miles in length, extending from Broughty Ferry in the Tay to Girdleness, and comprising 22 fishing villages, employing 298 boats and 1154 men; at Auchmithie and Johnshaven, two of the principal villages, having respectively 37 and 10 boats, which follow the long-line and lobster fishing with much success, there is no pier or landing place whatever, and the want of accommodation is much felt by the fishermen. Off Cowie, on the north side of the bay, is a projecting ledge of rocks, called the "Touties," sheltering a creek which at half-tide may be run for when other places cannot be attempted: here are 14 boats. PORTLETHEN, a creek well defended by a reef of rocks, called "Craig Maron," has 13 fishing-boats; and FINDON, noted for its cured haddocks, has no landing-place for its 12 boats to land their fish.

See plan, p. 268.
App. No. 186.
App. No. 494.

ABERDEEN.

ABERDEEN, at the mouth of the Dee, immediately to the north of the well-known promontory of Girdleness, now takes rank in point of revenue as the fourth port of Scotland. In spite of its few natural advantages, it is rapidly advancing in wealth and commercial importance, and can boast of some of the finest steamers in the United Kingdom constantly plying between Aberdeen and London.

As far back as the year 1607 improvements began, by the erection of the south pier; but it was not till 1775 that the north pier, which is the great feature of the harbour, was designed by Smeaton. This pier, of rubble-stone, with a facing of ashlar work from low water upwards, is carried out 500 yards at right angles to the coast; the pier head was repeatedly washed down till finished in the present slipper form, having the stones clamped together with bars of iron. Rennie, Telford, Walker, Gibb, and other eminent engineers, were subsequently consulted on improving the interior of the harbour, and the result has been the diversion of the course of the Dee to the southward, and the conversion of the old channel along the face of the town-quays into a floating dock of 34 acres in extent, having 1570 yards of quayage with 19 feet depth, and 660 yards with 16 feet depth of water, affording accommodation for more than 300 vessels; the entrance lock to be 250 feet by 60 feet wide, the sill 21 feet below the level of high water, and the gates to be chiefly of iron. The lock is in course of construction under Mr. Abernethy, the resident engineer, and, as far as the works have proceeded, they appear equal to any of the kind in the United Kingdom. It is expected that they will be finished in the course of 1848; the estimate for the whole is 110,000*l.*

See section, p. 712.
See plan, p. 346.
App. No. 197.

The harbour is governed by 31 Commissioners, including the magistrates and town council; its revenue during the past year was 19,809*l.*, and the debt 217,909*l.* The registered tonnage belonging to the port is 335 vessels of 53,117 tons; of these 14 are steamers, one of which is

7 Vict. c. 72.

SCOTLAND.

App. Ev. p. 269.

of 1100 tons burthen. The traffic consists in 2234 arrivals of 285,490 tons; of these, 164 vessels of 21,146 tons were from the British colonies and foreign, and the customs duty amounted to 81,433*l.*

App. No. 196.

App. Ev. p. 270.

Besides a charter of King Charles I., in 1638, there are seven Acts of Parliament between the years 1773 and 1843, for deepening and maintaining the harbour of Aberdeen. In preparing the last Bill, the Commissioners took great pains to procure information, and drew up a valuable Report, accompanied by a sheet of plans drawn to the same scale, of all the designs that had been proposed. The Act gives authority to raise 270,000*l.* In addition to the chief works of improvement before mentioned, and a spillwater channel which does not appear to be of any use, the harbour has been widened and deepened since 1840; some sandbanks at the entrance of the harbour have been dredged away, a portion of Abercrombie's Jetty has been taken down (and the rest ought to follow); several old warping posts and cairns of stone have been removed from the channel; 330 yards of new wharfage have been built, and efficient lights have been placed to lead into the harbour. Until the Admiralty plan of 1833, the soundings in the harbour and over the bar had been measured from no fixed datum line, which is extremely to be regretted; but as far as can be collected from the Report of Rennie in 1797, as compared with its present state, there has been a gain of 6 or 7 feet in depth over the bar, and as much as 10 feet in some parts of the harbour; and at high-water spring tides the depth at the entrance is now 19 feet; the width between the pier heads is 380 feet, and between North Capstan Point and the opposite jetty, at an extremely inconvenient spot where the long steamers are obliged to turn almost at a right angle, about 350 feet.

Answers to printed queries.

App. Ev. p. 272.

It appears that, at ordinary spring tides, the difference of level between high and low water in the harbour furnishes about one million cubic yards of backwater on each tide; the river Dee in its ordinary state is said to discharge about double this amount of fresh water on each tide (though we do not know on what data this estimate is formed), and the bed of the river and the spillwater channel together afford a reservoir for about three-quarters of a million of cubic yards of tidal water. Now, the floating dock of 34 acres in course of erection will exclude considerably more than half a million yards of water on each tide, or one-third of the whole; the proposed diversion of the Dee and the embankment of 80 acres of ground, over the greater part of which we believe the high tides now flow, will exclude at least as much more, and it will require much caution in carrying out these works, and a heavy expense will be incurred in providing full compensation for this large amount of water about to be excluded, for Aberdeen bar cannot afford to lose one foot of tidal scour. The intelligent resident engineer is fully aware of the necessary works, but will the funds be forthcoming, after the dock shall be completed, to enable him to deepen the channel of the river above the bridge, as far as is requisite to obtain a similar tidal reservoir.

Answers to queries.

There are several building slips at Aberdeen, employing 600 shipwrights, and many of the finest vessels in the kingdom have been built here; the foundries are capable of making and repairing all sorts of steam machinery; there are three patent slips, but no graving docks. Besides the 2080 yards of wharfage within the floating basin, there will be 370 yards in the tidal harbour; there are seven cranes on the quays, and a pair of sheers for lifting machinery of 20 tons weight. There is a steam dredger of 17-horse power, which lifts 300 tons of soil a-day, at a cost of 4¼*d.* a-ton. The seafaring population of the port is 2300; there are 40 pilots, and a life-boat. The fine steamers that trade between Aberdeen and London have adopted the true principle of lighting by night; they carry two distinguishing lights vertical, and on the line of keel, one at the mast head, or near the top of the funnel, the other on a stancheon at the stem.

App. Ev. p. 270.

Printed Accounts.

The salmon fishers on the Dee, as well as on the Tay and elsewhere, have thrown great obstacles in the way of improvement; the rental of the fisheries in the river and along the shores is about 6000*l.* The cost of the several Acts of Parliament for improving the harbour for public benefit has exceeded 15,000*l.* A breakwater has been proposed, to extend from Girdleness in a curved line to the northward, and enclose an area of 20 acres, having a depth of 4 fathoms and upwards. Nigg Bay, just to the southward of the Ness, has also been spoken of as a site for an asylum harbour.

App. No. 192.

It is worthy of notice that as far back as the year 1805, Jessop and Telford, in a joint report on Aberdeen Harbour, recommended the use of a steam-dredging machine for "deepening the bar;" this is the first mention, in Scotland, we believe, of the application of steam to this machine, which has since proved itself to be the great cure—the only efficient remedy—for our harbours. Its earliest application was by Grimsbawe in 1796, and Bentham in 1802; but the first use of the steam-dredge in Scotland was probably by Telford, on the Caledonian Canal, and on the Clyde in 1824, and whether applied in deepening a river or a harbour, the best results have invariably followed in proportion to the freedom with which it has been used.

App. Ev. p. 271.

The further alterations proposed at Aberdeen are, to deepen the entrance, to divert the river still more to the southward, to deepen and widen its channel, to remove the great obstruction of the North Capstan Point, to take down the south pier, and to make a sloping beach, to be continued easterly to the breakwater at the south side of the entrance of the harbour. These are large and expensive works, and although the harbour revenue has doubled within the last fifteen years, and will probably go on increasing, they cannot be completed without burthening the port with a heavy debt. We are far from wishing to discourage improvement and rightly-directed enterprise; on the contrary, we are of opinion that the best and most economical mode of dealing with a harbour is to make a large outlay on a well-matured plan at once, and to follow it up till completed;—but if the real welfare of the shipping interest had been the main object in view, it would have been more prudent to have first deepened the entrance, and to have widened and dredged the river, so as to have compensated for the large amount of tidal-water about to be excluded by locking up the greater part of the present reservoir, since no amount of internal accommodation could make up for the decrease of even a foot of water over the bar, or compensate for the risk to life and property incurred by waiting several hours in an easterly gale in the bay for tide to enter the harbour.

NEWBURGH lies on the south side of the river Ythan, at half a mile within its mouth. There is a depth of 11½ feet on the bar at spring-tides, but the channel is shifting, and requires caution in approaching it. The arrivals in 1846 were 97 vessels of 7125 tons, and the revenue 156*l*. The Ythan is navigable by small craft for a few miles higher, and might be deepened to Loggie Buchan and Ellon, from 5 to 8 miles up the river, which would afford great facility for trade to that district of the country.

NEWBURGH.

BODDAM, a fishing village immediately north of Buchanness, has two small harbours, well protected by the outlying rocks, frequented by 69 boats, and 168 men employed in the herring fisheries. As this is the nearest shipping place for the well-known Sterling Hill pink granite, it might be worth while to enlarge and complete the north harbour, so as to give shelter to coasters. Revenue, 67*l*. for 1846, and the arrivals, 39 vessels of 1691 tons.

BODDAM.

9 Vic. c. 25.

PETERHEAD holds a central station between the great Friths of Forth and Moray, and from its advanced position on the eastern extreme of the coast of Scotland, it forms a turning point in the navigation of these much-frequented shores. It is also well known as the head-quarters of the Greenland whale fishery, and latterly has become the principal herring fishing station on this part of the coast.

PETERHEAD.

Peterhead has the great advantage of n north and south harbour, respectively of 11 and 7 acres in extent. The south harbour was designed by Smeaton in 1773, and completed in 1781: it was enlarged and deepened by Rennie in 1807; the north harbour was planned by Rennie in 1806, partly executed by Telford in 1820, and completed by Messrs. Stevenson in 1827. The harbours are formed by connecting two small islands, which lie off the shore with the mainland by a central causeway, with the addition of piers north and south, leaving an entrance 90 feet in width. The south harbour is quite dry, and the north nearly so at low-water springs, with an 11 feet rise of tide. There is a graving dock on the east side of the north harbour, 130 feet long: entrance, 34 feet wide: length of quays, 380 yards in the south and 740 yards in the north harbour; a fixed red light is shown at the south-west pier-head.

See plan, p. 346.

App. Nos. 206-7.

See section, p. 712.

App. Ev. p. 301.

At a very early period the situation and usefulness of the harbour at Peterhead attracted public attention and support; the Government and the Convention of Royal Burghs have assisted it with funds, as well as the trustees of the Merchant Maiden Hospital at Edinburgh, who hold the chief property in the town. In the years 1808 and 1818 the Commissioners of Highland Roads and Bridges contributed 16,000*l*. (against a similar sum raised by the trustees) towards the erection of the piers; and the total expenditure on the two harbours since 1797 exceeds 67,000*l*. The arrivals last year were 672 vessels of 40,674 tons, including 109 vessels from foreign, besides 230 vessels, the average number for the last 12 years that have put in wind-bound. There are 14 Greenland ships belonging to the port, and more than 100 American, Archangel, and Baltic ships call annually for orders. The harbour revenue is 3372*l*., and the debt 32,961*l*. Besides the whale fishing, Peterhead is the great resort of the herring fishery on this coast; 395 boats, employing 2000 men and boys, fished from this place during the past season, and were it for these boats alone the harbour should be deepened, as much damage often arises both to the boats and fish by the entrance being blocked up by boats returning at low water of spring tides.

App. No. 209.

App. No. 489.

8 Geo. IV. c. 34.

Peterhead has often been spoken of as a site for a deep-water harbour of refuge, and its advantageous position, as the easternmost headland on the coast of Scotland, the long list of wrecks that have taken place in its immediate neighbourhood, the number of wind-bound vessels seeking shelter, the vicinity of granite quarries, and other reasons adduced by the eminent engineers whose Reports will be found in the Appendix, are strong points in its favour. But as such a work must be a national undertaking, the trustees will, in the mean time, better consult the real interests of the harbour by carrying out the minor works quite within their means, and which the increasing demands of shipping fully warrant, such as deepening the south harbour and improving its entrance, by the removal of the dangerous rock called the Maw Craig, by laying down a patent slip, and especially in making a communication between the two harbours, an improvement so simple and so obvious that it is difficult to understand why it has been so long delayed, and without which half the advantage of the fine natural position of Peterhead is thrown away.

App. No. 213.

App. No. 215.

App. No. 214.

App. Ev. p. 301.

FRASERBURGH is only second to Peterhead in position, being close to the promontory of Kinnaird's Head, the landfall, or point of departure for all vessels coming from or bound to the north, and directly in the track of the chief trade of the Moray Firth and Caledonian Canal. It is also the head-quarters of a fishing district 22 miles in extent, employing 456 boats and 950 men and boys.

FRASERBURGH.

See plan, p. 346.

It appears that, as early as 1745, a stone pier was built in Fraserburgh Bay. In the year 1807, Rennie designed the present North Pier, which was constructed of granite, and completed in 1811, at a cost of 11,250*l*., half of which was paid by Government; the south pier was built by Stevenson in 1818, the middle pier or jetty in 1830, making, with excavation, the sum of 25,702*l*. expended on the harbour. The area thus enclosed is 8 acres in extent, and has a depth of 15 feet in the outer harbour and 12 feet in the inner at high-water spring-tides. The arrivals in 1846 were, 341 vessels of 18,065 tons, of which 34 vessels were from the colonies

App. No. 225.

App. No. 489.

App. No. 224.

SCOTLAND.

2 & 3 Vic. c. 63.

and foreign. The revenue is 2218*l*., and the debt 12,496*l*. Vessels which stand in need of it will find here the great convenience of a patent slip.

App. No. 223.
App. No. 221.

Fully 300 fishing boats, 109 of which belong to the place, resort here every season, and great complaints are made by the fishermen that harbour accommodation does not keep pace with the increase of trade, and that there is great want of curing ground; complaints, too, are made of the little value of the North Harbour, owing to its great exposure. A design for an extension of pier, so as to give the requisite shelter, has been prepared; but the estimate of 20,000*l*. is considered too heavy for the harbour funds; yet looking at the position of Fraserburgh, the refuge it affords to wind-bound vessels, and the extent and value of its fisheries, there are few places on this coast on which such a sum could be more beneficially expended.

PITTULIE.
App. No. 227.
App. No. 494.

At PITTULIE, or rather at Sandhaven, a quarter of a mile to the eastward, a harbour was constructed by the Fishery Board, in 1838, from a design by Mr. Mitchell, C.E. The main piers extend 150 yards off-shore in an east-north-east direction, with a return head of 43 yards to the south-east; cost 4205*l*., three-fourths of which were contributed by the Board on the part of the public. Here are 45 fishing-boats; the harbour is well sheltered and smooth in all winds. The dues last year levied by order of the proprietor, amounted to 41*l*. Rosehearty is a very small harbour, sheltered by two high piers; it has 74 boats. The dues, levied by charter of King Charles II., were 75*l*. Cairnbulg, Inveralochy, and St. Comb's, are creeks affording shelter respectively to 66, 77, and 46 fishing-boats: they have no piers nor any harbour accommodation whatever.

MACDUFF.
See plan, p. 346.

MACDUFF, lying on the eastern side of the Bay of Banff, has the great advantage, on this part of the coast, of a western aspect, and is thus partly sheltered from the heaviest gales, although there is still a heavy run of the sea in the harbour. The present harbour contains an area of about 3½ acres, enclosed within stone piers, built, in 1820, at the expense of the Earl of Fife, to whom the harbour belongs; the whole area is dry at low-water, and there is a depth of 14 feet at the pier heads, and 11 feet at the quays, at high-water spring tides. Besides numerous fishing-boats, Macduff has a thriving coasting trade, and the harbour dues were leased for 221*l*.

App. No. 231.
App. No. 232.

The want of a low-water harbour, accessible at all times of tide, being much felt on this coast (as there is none from Cromarty to the Tay, a distance of 200 miles), it is proposed to throw out breakwater piers, enclosing an area of 7 acres, and to have 22 feet at the pier-heads at low-water spring tides; the northern pier to extend from the elbow of the present east pier for 190 yards, in a north-west direction. This bold undertaking is to be carried out at the expense of the noble proprietor of the harbour and of the adjoining estates. The design for the harbour is by Mr. Bremner, C. E., and as from the exposed nature of the coast it is necessary to complete the work as rapidly as possible, he proposes to build a nearly vertical wall, to be put together in large masses floated out in caissons, and to be sunk at once into their places. It seems desirable that the northern arm of the breakwater should be first carried out as a test of the mode of construction proposed, and as most essential to the security of the harbour, and it is with this condition that the Admiralty has given its assent to the measure. In the course of improvements, the Collie, a detached rock, covered at half tide, lying a quarter of a mile north-east of the pier-head, should have a conspicuous perch placed on it, or be blasted away.

BANFF.
See plan, p. 346.

BANFF, on the western side of the same shallow bay, has had greater natural difficulties to contend with; nor do these difficulties seem to have been grappled with by any well-considered plan: make-shifts apparently have been adopted from time to time as any one defect became more prominent than another, and the consequence has been that jetty upon jetty and pier after pier have been built, till the interior of the harbour has become a labyrinth of stone walls. There is, however, much to be said in excuse; the evils of a shallow bay, of a river bringing down large quantities of sand, and of an exposure to north-easterly gales, were not easy to be dealt with; and seeing that such difficulties were unavoidable, it would have appeared the more prudent plan for the trustees to have limited their views to making the most of their small tidal harbour, rather than to have aimed at excavating an outer harbour, or at carrying out an expensive pier into deep water.

App. No. 489.
See section, p. 712.
App. No. 236.
App. No. 235.

The present harbour consists of an outer and inner basin, having an area of about four acres, enclosed by piers; the inner harbour was built at an early period, and was formed by a north quay and an eastern pier placed on a projecting ridge of rocks, and within these containing a western pier and two jetties. As far back as the year 1806, the inhabitants desired to enlarge their harbour by enclosing an inlet to the northward, used as a boat harbour; and in 1818, Mr. Telford having given a plan for improvement at an expense of 14,000*l*., one-half the sum was raised by public subscription, and the remainder contributed by Government out of the Forfeited Estates Fund. The work was far advanced towards completion, when in the great storm of the 22nd October, 1819, a portion was beaten down by the waves, and repaired by a further joint contribution of 2000*l*. This outer north pier or breakwater is of rubble-stone faced with ashlar, with a long slope to seaward; the pier is 11 yards in width at the surface of high water, and 33 yards at its base. In 1837, only 17 years after its completion, this pier was found to be in so insecure a state from the action of the waves upon its long sea slope, and from its being placed exactly at right angles to the greatest force of the waves, that it was necessary to protect it by chain cables, iron clamps and blocks of stone, varying from 15 to 40 tons weight, which latter were ingeniously transported by Mr. Bremner, C.E., and dropped along the outer edge of the breakwater, and thus it remains at present.

The arrivals at Banff in 1846 were 190 vessels of 11,560 tons, of which 16 vessels

SCOTLAND.

were from the colonies or foreign, and the customs dues amounted to 1849*l*. The tonnage belonging to the port was 111 vessels of 8714 tons, the revenue, levied by the Act of 1840, was 836*l*., and the debt 8071*l*. The remedy that has been proposed for some of the chief evils under which the harbour labours, and which seems within the reach of a moderate outlay, is to close up the entrance to the new harbour, to deepen and improve the entrance to the old one, and to open a communication between them; to shorten the central quay, and remove one or both of the small jetties, and make a slope and beaching-place at the upper end the Old Basin for the swell to expend itself, and for vessels to check their way upon when running in before a gale; to deepen the channel and harbour generally, to blast away the Bobby Leel Rock lying just at the entrance—a disgrace to any harbour, and to turn the course of the Dovern as far as possible away from the harbour's mouth.

3 & 4 Vic. c. 114.

App. No. 237.

PORTSOY.

PORTSOY, Cullen, Whitehills, and Gardenstone, are small pier harbours, having respectively 12, 30, 25, and 18 fishing boats belonging to them. Portsoy has an inner and outer harbour, with 10 feet water on springs, and a fair district trade in grain and coals. Its revenue for the last year was 441*l*., and the arrivals, 112 vessels of 6046 tons. Cullen has the disadvantage of being situated at the east end of a long flat shore, and is continually liable to silt up. Its revenue is 118*l*., and the sum expended by the proprietor on the harbour appears to be 13,000*l*. The three first-named creeks, as well as Blackpots, are on the estate of the Earl of Seafield. Portknockie has no pier, but more natural protection than any creek along this part of the coast: it employs 81 fishing-boats and 410 men. Findochtie, a small deep-water creek, has 38 boats, and Port Essie 50.

App No. 240.

App. No. 242.

App. No. 241.

BUCKIE.

BUCKIE, well known for its fine fishing boats, and its spirited fishermen—who steadily pursue the deep-sea fishery all the year round, and thus really deserve the name of fishermen—employs 163 boats and 815 men. It has no pier nor harbour, except what these industrious men have recently constructed from their own resources; indeed, throughout this populous district, from Port Gordon to Speymouth, one of the earliest and best fishing stations, occupied by 416 boats, employing 2,100 men, there is a very great want of barbour accommodation, which acts as a great discouragement to the fishery.

App. No. 494.

PORT GORDON.

PORT GORDON has a small district trade, and the arrivals last year were 76 coasters, of 4500 tons, besides 38 fishing boats, manned by 196 men belonging to the place. Its revenue is 189*l*. At Garmouth and Kingston, on the west bank, at the entrance of the Spey—the most rapid river in Scotland—a thriving trade in ship building and in railway sleepers is carried on, from the abundant supply of larch and fir which flourish on the banks of the Spey; but there is no pier, and the outlet of the river is gradually working its way to the westward, to the damage of the houses in Kingston. The arrivals last year at Garmouth were 106 vessels, of 5254 tons; the dues levied by authority of the proprietors were 64*l*.

App. No. 244.

LOSSIEMOUTH.

LOSSIEMOUTH old barbour is formed by the outlet of the river, which falls into a shallow sandy bay, between stone piers, now in a dilapidated state, and the channel is much sanded up. The new harbour at Stotfield, at a quarter of a mile to the northward, lies on the east side of the extreme rocky point of Coulard Head; it has been chiefly quarried out of the solid rock, and the stone used in building a massive breakwater pier to shelter the harbour from north-easterly gales. The harbour consists of an inner and outer basin of about two acres, affording 220 yards of quayage, having a depth of 12 feet at high-water spring tides: the entrance facing the south-east is 60 feet wide. The north quay and inner basin have recently been extended, at a cost of 4190*l*. The arrivals and sailings in cargo during the past year were 121 vessels of 7650 tons; the harbour revenue was 905*l*., and the debt 8000*l*.

See plan, p. 346.

App. No. 491.

Lossiemouth may be considered the sea-port of Elgin, from which town it is distant about five miles; the merchants and tradesmen of that burgh, in 1834, finding the old harbour very inadequate to the increasing trade of the district, formed a joint-stock company, and obtained an Act of Parliament empowering them to raise 20,000*l*., in order to construct a harbour according to a certain deposited plan, and to levy dues in proportion according to a certain schedule of rates. It appears, from documents printed in the Appendix, that no sooner was the Act obtained than the proprietors, finding that the proposed harbour was likely to cost too much money—and fully aware that there was no authority to control their actions or guard the interests of the public—proceeded to erect a harbour upon a plan totally different from the one for which an Act of Parliament was obtained, costing less money, and affording less accommodation, but for which they levy upon the public the maximum dues allowed by the Act. It further appears that there is no competent harbour-master, no pilots, no warping-buoy, and apparently no one acquainted with the requirements and wants of sailors and shipping connected with the harbour.

4 & 5 Will. IV. c. 86.

App. No. 246.

App. No. 247.

COVESEA SKERRIES.

COVESEA SKERRIES.—Three miles to the westward of Coulard Head is the salient point of this line of the coast, off which lie the dangerous reefs of Halliman's Scars, and Covesea Skerries, the former marked by a beacon, the latter by a brilliant revolving light, 160 feet high, and visible 18 miles, recently placed by the Commissioners of Northern Lights, and first lighted on the 15th May, 1846. Until this period, the extent of coast from Kinnaird's Head to Inverness, a distance of 70 miles, remained without any light.

HOPEMAN.

HOPEMAN is a small cove, formed in the sandstone rock, chiefly for the purpose of shipping stone from a quarry. It is covered by a pier, making a sort of outer and inner barbour, with

SCOTLAND.

an entrance 36 feet wide. A heavy north-west gale in 1844-5 made a breach through the pier, which has been converted into an entrance provided with boom gates in case of need. There is a depth of 17 feet at the pier-head at high-water spring tides. Besides a small district trade there are 38 fishing-boats, employing 114 men and boys belonging to the place; a good fishing-ground lies immediately outside the harbour.

BURGHEAD.

See plan, p. 346.

App. No. 251.

BURGHEAD, or **BROUGHEAD** harbour, immediately to the westward of the bluff, rocky promontory of the same name, has an area of about two acres; the entrance is sheltered by a pier extending 80 yards to the south-west, and continued by a timber jetty of similar length. Owing to its western aspect and sheltered position, there is never any very heavy sea off the entrance, and the harbour may always be safely run for at tide time. The harbour was built in 1809; the first extension of the jetty, or breakwater, for 40 yards, was made in 1834, and a similar extension in 1839. There is a depth of 16 feet alongside the pier at high-water average spring tides. The cost of the harbour has been 24,321*l.*, at the sole expense of the public-spirited proprietor of Burghead. The arrivals last year were 341 vessels, of 22,477 tons; the revenue, levied by charter, 395*l.* This is a considerable fishing station, with 31 boats, employing 104 men and boys.

FINDHORN.

App. No. 253.

FINDHORN lies on the north-east side of its loch or haven, which has a shifting bar at its entrance, having 14 feet over it at high-water ordinary spring tides, but it is not safe to take it in north-easterly gales. The bar gradually works to the westward, to a certain point, when it breaks out again to the eastward. There are two good piers at the village, and vessels drawing 12 feet can reach them in fine weather. A thriving trade is carried on in coal, lime, and railway sleepers, cut from the neighbouring larch forests. The arrivals last year were 214 vessels, of 13,600 tons, four of which vessels were from foreign, besides 68 calls of passing steamers. The revenue, levied under an Act of 1777, was leased for 625*l.* Salmon in large quantities is taken here, and 19 boats are employed in the herring fishery.

NAIRN.

See plan, p. 346.

App. No. 257.

NAIRN is a fishing station, employing 12 large boats and 62 herring boats, manned by 171 men. The mouth of the river constitutes the harbour, and the entrance is both narrow and shallow, but with a rise of 14 feet of tide on springs. The old channel of the river, on arriving near the shore, took a sudden bend to the eastward, and ran for some distance parallel to the coast before reaching the sea. Telford, in 1820, gave it the direct course which it now holds, at a cost (including compensation paid to a salmon fishery) of 5500*l.*; but most of the harbour works were damaged by the great flood of 1829. Whether the change of direction of the stream was any improvement seems doubtful: the fishermen state, that within their memory a vessel of 200 tons has come in by the old channel, and that as many as 17 vessels have been seen in the harbour at one time; at the time of our visit, only fishing-boats and coasters could enter.

App. No. 266.

To remedy this inconvenience a rubble-stone and timber breakwater, 400 yards long, and very slightly curved, is being run out at right angles to the line of coast, on the east side of the channel, as far as low water. Its estimated cost is 3000*l.*, whereof one-half to be paid by the Fishery Board and the other by the burgh. This measure must be considered a bold experiment on an exposed shore with a structure apparently so feeble, and, if successful, will do credit to the engineer in obtaining so much benefit at so small a cost. The arrivals in 1846 were 71 vessels of 4556 tons, and the revenue 106*l.*

INVERNESS.

INVERNESS, the capital of the Scottish highlands, at the outlet of the great valley of the Ness, with a well-sheltered anchorage at the head of the Beauley Frith, a tractable river without a bar and a 14 feet rise of tide, has many natural advantages, but which do not seem hitherto to have been turned to the best account.

See plan, p. 376.

48 Geo. III. c. 41, s. 11.

App. Ev. p. 347.

The harbour consists of the sea-reach of the river Ness, and, with the exception of the Thornbush Quay and a small dock near the town, it remains in a state of nature; whereas there is not around the coasts of Scotland a river to which the dredging-machine could be applied with more beneficial results. The affairs of the harbour have been managed by the Town Council, under an Act of Parliament obtained in 1808, which specially enjoins "deepening, scouring, and cleansing the harbour: yet, while the shipping dues have produced nearly 600*l.* a-year for the last quarter of a century, only 180*l.* a-year has been laid out on the harbour; the natural consequence has been, that vessels that might have come up to the town quays to discharge their cargoes, have been compelled to resort to the basin of the Caledonian Canal for that purpose.

App. No. 492.

App. Ev. p 347.

In spite of this inattention to the obvious interests of the port, there has been a rapid improvement in trade; the arrivals and sailings in cargo during the past year were 764 vessels, of 82,519 tons; of these 11 vessels were to and from the British colonies and foreign, and the customs duty was 6154*l.* The harbour revenue also has proportionably increased, having more than doubled within the last ten years, and is now 1,180*l.* By an array of figures, not easy to be understood, it is made to appear that the harbour, notwithstanding the small outlay upon it above mentioned, is indebted 3498*l.* to the corporation.

One difficulty at Inverness, which hitherto appears to have been overlooked, is the great fall in the bed of the river: the fall from Loch Ness is 45 feet in a distance of seven miles, in consequence, the tide barely reaches two miles up the river, and a flood-stream is almost unknown; nor has this been improved by the works connected with the recent repairs of the Caledonian Canal, during which the regulating weir, at the issue of the waters of Loch Ness into the river, has been somewhat raised, and however much the additional depth may have

SCOTLAND.

benefited the canal, it has at the same time given so much additional descent and velocity to the waters of the river, and increased its powers of transporting sand and gravel.

App. Ev. p. 349.

With reference to the lighting and buoying of this part of the coast, it appeared in evidence that heavy, and, we are compelled to add, well-founded complaints were made of the utter want of buoys and beacons in the approaches to this port, and that while the Caledonian Canal had been open for traffic for a quarter of a century, yet until the 11th May, 1846, no light had been placed as a guide into the entrance of Inverness, although repeated wrecks had occurred; and that at the time of our visit, when the Caledonian Canal was about to be re-opened, and a far more extended traffic was expected, there was not a single buoy or beacon to mark seven dangerous shoals which line the channel on either side.*

App. No. 267.

A Bill has been brought into Parliament during the present session creating a distinct trust, composed of 17 persons, for the management of the harbour and its funds. Its enactments are conceived in a highly liberal manner for the shipping interests, and confer much credit on the promoters of the measure. It empowers the trustees to raise 25,000*l.* for its improvement, and to carry out a plan for widening and deepening the channel, but without disturbing the general course of the river as now existing. If this plan be acted upon with energy, and the harbour revenue be faithfully applied to its legitimate use, there is little doubt of the rapid increase of the traffic of the port of Inverness.

CALEDONIAN CANAL.

The CALEDONIAN CANAL, a line of inland navigation, 60½ miles in length, extends in a north-east and south-west direction, through the great Caledonian glen, from Inverness to Fort William. The peculiar formation of this valley, occupied for the greater portion of its length by a chain of inland lakes and extensive inlets of the sea, had long suggested the idea of a canal, which, by connecting the whole, might afford the means of a navigable communication between the opposite sides of the island, and thus save 350 miles of intricate and stormy navigation through the Pentland Frith and the Great and Little Minch.

As early as 1774, James Watt reported in favour of a canal on this line, having locks 25 feet wide, with 10½ feet depth of water; but nothing further was done. In 1801, Telford was employed to examine the site; in 1803 he reported favourably on it, and in 1805 the works were begun, with the intention of completing them in seven years, at an estimate of 350,000*l.*, the locks to be 170 feet long by 40 feet wide, and the canal to have a depth of 20 feet water throughout. As in most similar works, the estimate of time and cost was far under the mark, and, after numerous delays, the canal was opened for use, in an unfinished state and with a depth of only 15 feet, in the year 1822—the total cost up to that period having been 905,258*l.*

The north-eastern entrance of the canal is at Clachnaharry, on the Beauley Firth, and one of the most difficult operations in the formation of the canal was the construction of the sea lock at that place, owing to the flatness of the shore and to the bottom being of soft mud, quite unfit to bear a solid structure of masonry. The sea lock, with a depth of 7 feet over the sill at low water and 21 feet at high-water spring tides, opens into a lower basin, and a second lock of 8 feet rise into an upper basin of 30 acres area; thence a rapid ascent of 32 feet, by means of the four united Muirtown locks, each 180 feet long by 40 feet wide, leads to the level of Loch Ness, which is reached at 6½ miles from Loch Beauley. This lake extends 23¾ miles to Fort Augustus, where, by means of five connected locks, is a further rise of 40 feet. A canal, 5½ miles long, in which are two more locks, joins Loch Ness to Loch Oich, the surface of which, at its ordinary summer level, forms the summit level of the canal at 100 feet above the sea at high water of ordinary neap tides.

Caledonian Canal Report (551), 1839.

Loch Oich is 3¾ miles in length; this lake was very shallow and required much dredging to form a navigable channel; a greater difficulty was caused by its alteration in level, which has been known to vary as much as 9 feet, falling to 18 feet, and rising to 27 feet above the sill of the lock gates in the great flood of November, 1834. A cutting, 1¾ miles in length, having a descent of 9½ feet, connects Loch Oich with Loch Lochy. This latter lake is 11 miles in length, and, like the former, is liable to great variation of level. For the purposes of the navigation, this large sheet of water, about 6000 acres in extent, has been raised 12 feet above its natural level, by means of a weir across its original outlet and the formation of an artificial channel at a higher level. This was rather a hazardous state of things so long as there was but one lock to accommodate the rise of floods to the conditions of the navigation but there has recently been placed a new lock, with two pairs of gates (affording two additional lifts for any excessive rise), thus rendering this part of the canal fully as secure as any other portion. From Gairlochy, the canal-reach extends about 6 miles to the head of the Bannavie locks, where commences a rapid descent of 64 feet by a connected chain of 8 locks, familiarly known by the name of Neptune's Staircase: from this spot, a mile and a quarter of canal leads to Corpach, where, by means of two locks, the level of the sea is again reached and the canal opens out by a sea-lock into the tide-way of Loch Eil.

The whole length of the navigation from the North Sea to the Atlantic is 60½ miles, 37½ miles of which are by the three lakes Loch Ness, Loch Oich, and Loch Lochy, leaving only 23 miles of artificial canal. The width of surface is 120 feet, of bottom 50 feet; hitherto the depth has been only 15 feet, and that maintained with difficulty. In 1843 the works were found to be so much out of repair that it became necessary to close the canal; since that time about 150,000*l.* has been expended in repairs and in increasing the depth of water, which, by means of dredging and raising the weirs, is now stated to be 17 feet throughout, with a depth of 20 feet at both entrances at high water of ordinary neap tides, and with wharfage accommodation at each end for the local trade, and the canal was again finally opened for traffic in April, 1847. The works have been carried out by Mr. George May, as resident engineer and superintendent, under the direction of Mr. James Walker as engineer-in-chief. In the year ending on the 1st May, 1839, the number of vessels that had passed through was 328 from east to west, 226 from west to east—total 554 vessels of 25,000 tons burthen, exclusive of 526 passages on parts of the canal and 175 by steamers. An uniform rate of ¼*d.* per ton per mile was formerly charged on all vessels using the canal, and the gross receipts hitherto have not exceeded 2500*l.* a-year; the total outlay amounts to about 1,170 000*l.* The rates now proposed are 1*s.* a-ton on all vessels in ballast, 1*s.* 6*d.* on those carrying cargo, and 2*s.* per ton on the registered tonnage of steamers; a sailing-vessel may go through easily in two days, a steamer in 12 hours from sea to sea. Of the value of such an inland communication, avoiding the tedious and stormy passage round the north of Scotland, there can be no doubt, and there is every probability now that it is amply furnished with steam-tugs and the works are kept in effective repair, that it will confer important advantages on the commercial interests of the kingdom, advantages which would be greatly enhanced in case of war.

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* These buoys and beacons have since been placed.

AVOCH, OR AUCH.

App. Ev. p. 349.

AVOCH, or AUCH, on the north shore of the Beauley Firth, well known for its industrious fishermen, and its taunt-rigged fishing boats, has a small pier harbour, sheltered by a breakwater to the eastward, built in 1814, at a cost of 1056*l.* Here are 48 fishing-boats, employing 192 men and boys. Fortrose has a harbour with high piers, and 11 feet depth; it was finished in 1817 at an expense of 4000*l.* Chanonry Point, a dangerous spit of shingle projecting almost a mile from the shore, on which many a vessel has been beached, is now marked by a fixed light, first shown on the 15th May, 1846. A small ferry pier, for communicating with the opposite point at Fort George, was constructed here, at a cost of 1300*l.* This pier, as well as the harbours of Avoch and Fortrose, was built at the joint expense of the respective proprietors and the Commissioners of Highland Roads and Bridges. Fortrose also received 630*l.* in aid, from the Convention of Royal Burghs.

CROMARTY.

CROMARTY FIRTH, well marked by the bold twin headlands, known as the Sutors of Cromarty and the lofty Ben Wyvis, or Hill of Storms, in the distance, is the only real harbour of refuge on this part of the coast of Scotland. The entrance, clean and bold, is three-quarters of a mile wide, when the Firth opens out into an expanse 20 miles long, and varying from one to three miles in breadth, with an average depth of 12 fathoms, affording anchorage for the whole British navy.

See plan, p. 376.

App. No. 269.

The small tidal harbour of Cromarty, just within the entrance on the south side, is formed by two piers, and a detached breakwater, built at the joint expense of Government and the proprietors, in 1785. The revenue last year was 65*l.*, the debt 1100*l.* Here are 50 fishing-boats, employing 200 men and boys. Steamers from Leith and Inverness call here during the summer. The arrivals in 1846 were 115 vessels, of 7401 tons, exclusive of 600 vessels which sought shelter in the firth, where occasionally may be seen from 50 to 70 vessels at a time, showing the value of this secure anchorage in the heavy easterly gales to which this coast is so much exposed. A light was first exhibited here in May, 1846; it is red, and fixed.

INVERGORDON.

App. No. 487.

INVERGORDON, on the north shore of Cromarty Firth, has a good pier, 133 yards in length, having a depth of 14 feet at high-water spring tides; and a projecting timber jetty for the accommodation of steamers that call here during summer. A ferry is established from hence to Inverbrechie, three-quarters of a mile across the firth, where is a similar pier, 90 yards long; these two piers cost 1638*l.* At Balintraed, three miles to the eastward, is a landing pier for the trade of the fertile district of Easter Ross. It is 100 yards long, with a return head, and was built in 1820, at a cost of 2400*l.* Dingwall communicates with the head of the firth by a canal, a mile long, having two wharfs, with a depth of 13 feet at spring tides. Here is a fair trade in timber and corn, and the revenue last year was 147*l.* The harbour and shore dues appear to be very high. The cost of the canal, and of draining a morass above the town, executed in the years 1815-17, was 4365*l.*, half of which was contributed by Government, as well as half the expense of the three above-mentioned piers; the Convention of Burghs also gave 600*l.* towards the Dingwall Canal.

At Tarbet Ness, the projecting peninsular point which forms the south-eastern limit of the Dornoch Firth, is a fixed intermittent light, at 175 feet above the sea, visible 18 miles.

PORTMAHOLMACK.

PORTMAHOLMACK has a substantial pier, extending 120 yards to the northward, with a return head of 23 yards, affording fair shelter in easterly gales; it was completed in 1816, at a cost of 3168*l.*, half of which was paid by Government. The arrivals and sailings in 1846 were 131 vessels, of 7666 tons; the revenue 53*l.* Here are 27 fishing-boats. In the whole of the Cromarty fishing district, extending from Inverness to Tain, there are 257 boats, employing 1018 men and boys; the fishing villages of Ballintore, Shandwick, Inver, and Hilton, respectively of 16, 17, 20, and 32 boats, have no harbour accommodation whatever, and the fishermen are thus frequently debarred from following their calling, while their neighbours are reaping an ample harvest of fish.

DORNOCH FIRTH.

Admiralty Chart, 1846.

DORNOCH FIRTH, or the FIRTH of TAIN, is a shallow barred estuary, encumbered with sands, the most noted of which, called the Gizzing Briggs, dries three miles off shore, and its outer edge is steep to. The bar has from 9 to 12 feet over it at low-water springs, with a 13-feet rise of tide; but unfortunately for the mariner, the leading marks for crossing it are so far off that they cannot be readily distinguished, and the use of buoys to mark out a channel does not yet appear to have reached this remote district.*

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* A fairway buoy and two channel buoys have recently been placed.

SCOTLAND.

About eight miles higher up the Firth, and four miles west of the royal burgh of Dornoch, the Firth is contracted to a width of three-quarters of a mile, and at this spot is established the well-known Meikle Ferry, perhaps the most dangerous and disagreeable passage in civilized Europe. By this ferry her Majesty's mails, and all the passengers, by the only public conveyance in this part of the country, are conveyed across the Firth twice in the 24 hours. On the arrival of the mail, at low water, on the Sutherland shore, the letters and passengers are turned out into a cart, which is driven out about half a mile over a flat, muddy sand, to low-water mark, where all is embarked in a rude open ferry boat, to find its way across as it best can. As during the winter the transit is made both ways after dark, and not unfrequently in an easterly gale and snow-storm, some notion made be formed of the comfort and dispatch with which mail communication is kept up between the important counties of Ross and Sutherland.

BONAR BRIDGE.

At BONAR BRIDGE, 8 miles higher up Dornoch Firth, and 16 miles from the bar, there is a pier at which coasters drawing 10½ feet can land their cargoes, but with some hazard, as the flood stream continues to run up rapidly for nearly an hour after high water, and the ground being loose, they risk being carried athwart the bridge. The tide rises here 6½ feet on springs, and the soffit of the main arch of the bridge is 44 feet above high water. Above the delta here formed by the river Carron, the Kyle of Sutherland widens to three-quarters of a mile, and the tide flows up 12 miles to the house of Rosehall, with sufficient water for large boats.

Admiralty Sailing Directions, 1846.

LITTLE FERRY.

LITTLE FERRY is the narrow channel by which Loch Fleet communicates with the sea; it has a bar of sand at its entrance, with from 14 to 16 feet water over it at high springs. The channel is marked by three buoys, which are not uncommonly driven away in the winter, owing to their ground tackling not being strong enough, and are not always replaced in the same position. The tide runs at the rate of five knots on springs. At three-quarters of a mile within the bar is good anchorage, in 17 feet at low water, and perfectly safe in all winds. On the north side is a sufficient pier or slip, having nine feet at low water, built at the expense of the Duke of Sutherland; but much inconvenience is occasioned by the want of a similar erection on the south side, which prevents vessels being loaded or discharged, except at tide time. The arrivals in 1846 were 41 vessels, of 2331 tons; the revenue 65*l.* In the summer a steamer calls here twice a-week. Should trade increase much in this district, Little Ferry will be found capable of being made a useful harbour. At three miles from the sea, the high road is carried across Loch Fleet, by a solid mound or embankment, 995 yards in length, having arches, with four sluice gates at its eastern end, to admit of the escape of the waters of Strath Fleet. This mound cost 9290*l.*, and with the roads of approach, 12,500*l.*; of which the public contributed 4700*l.*, the remainder was defrayed by the Marquis of Stafford. About 400 acres of land have been taken, or, as usually termed, reclaimed, from the sea, by means of the Fleet mound.

See plan, p. 376.
App. No. 272.
App No. 491.
Rep. on Highland Roads, 1821.

BRORA.

BRORA has a small inner harbour for coasters, not exceeding 9 or 10 feet draft of water at spring-tides. On the west side of the entrance, a reef of rocks, not covered till half tide, and extending a quarter of a mile into deep water, might possibly form the foundation of a breakwater, should the discovery of good coal, or any other cause, render it desirable to excavate a harbour here.

HELMSDALE.

HELMSDALE is one of the most thriving fishing stations on the east coast of Scotland, yet great want of room was felt in its limited river harbour for the 220 boats which fished from here during the past season. The entrance lies between two shingle points, marked by a fairway buoy, and having several beacons to point out the channel. There is usually a depth of 14 feet over the bar, and 10 feet up to the quays at high water spring-tides. The eastern side of the river was formed into a quay, 100 yards long, in 1831, and in 1840 a wharf wall was built, extending from the bridge, and, partly sheltering a sort of inner basin; but other improvements, recommended by Mr. W. Leslie, C. E., and especially dredging the channel and basin, have not been carried out. The arrivals last year were, 91 vessels of 4177 tons; the revenue 231*l.* Helmsdale is the head-quarters of a fishing district, extending from Dornoch to Dunbeath, a distance of 35 miles, in which are 152 herring boats, and 61 cod and ling boats; total 213 boats, employing 760 men and boys: 40 of these boats belong to Helmsdale, and 26 to Goldspie and Embo.

See plan, p. 376.
App. No. 494.

DUNBEATH.

DUNBEATH CREEK is slightly protected by a promontory and some detached rocks; a sea-wall is built on the north shore, and a breakwater of loose stones has been twice thrown up by the fishermen on the south side at the mouth of the burn. After heavy rains the water rushes down with great force, and causes sad havoc among the boats; yet, in spite of these difficulties, 103 fishing boats, employing 320 men and boys, belong to this creek. Berriedale, Latheron Wheel, Forse Bay, and Ach Castle, are smaller fishing villages, but all equally exposed to the weather.

App. No. 494.

LYBSTER.

LYBSTER lies in a well-sheltered nook, half way between Helmsdale and Wick, and has become a fishing station of some importance, in consequence of the erection of a pier 90 yards long, by the proprietor, in 1830, at his sole expense. As many as 100 large herring boats frequent this harbour during the season, and 55 coasters arrived last year. The revenue is 131*l.* It is also the head-quarters of a fishing district, 20 miles in extent, having 249 boats, manned by 1230 men and boys, and employing, including curers, &c., 2500 persons in the fishing business.

See plan, p. 376.

SCOTLAND.

App. No. 280.

The evils complained of are, that large quantities of gravel are brought down the burn with every fresh, and deposited in the harbour; that the pier requires to be extended about 20 yards; that the fairway is obstructed by large loose stones, by some detached rocks, and by a rocky ledge at the north-eastern horn of the bay, all of which might easily be removed, if the removal of the latter were thought desirable. A short distance without the pier-head there is deep water, while within there are several acres of flat land, forming a good curing ground. Although extremely limited, Lybster offers as good shelter as any harbour on the east coast of Caithness in an easterly gale for vessels not drawing more than 9 feet water; and the harbour might be readily improved at a small expense.

Fishery Rep. 1846.

The absence of any low-water harbour, even for fishing boats, along this extent of coast, from Cromarty Frith to Long Hope in the Orkneys, a distance of 80 miles, is a very serious consideration, when we remember that during the season it is frequented by more than 1000 fishing boats, manned by upwards of 5000 men and boys, not as occasional passers-by, but constantly hovering off the coast in pursuing their calling for three months together. The suddenness and violence of North-sea gales are notorious, and the lamentable loss of life on such occasions as in August, 1845, and many others on record, renders it imperative to take some measures to prevent its recurrence; one remedy would be, to construct a low-water harbour at the most central and most accessible spot, but it is probable that to deepen and make the most of all the small tidal harbours might be even more generally serviceable. Proverbially hardy and fearless as is the race of Scottish fishermen, it is not to be expected that they should continue to risk their lives in such a hazardous occupation if they are denied the common shelter that all mariners are entitled to look for in time of need.

SARCLET.

Fishery Rep. 1833.

See section, p. 712.

Sailing Directions, Hyd. Off. 1845.

SARCLET HARBOUR is defended from the sea by a massive breakwater pier, 35 yards in length, extending from the south shore, and a jetty from the north, leaving an entrance between 12 yards in width. The rocky ledges inside the harbour have been excavated, and a pitched sloping made for drawing the boats up in stormy weather. A former breakwater having been beaten down by the violence of the sea, in 1832, the present structure was erected in 1835, under the superintendence of Mr. Mitchell, engineer to the Fishery Board. It is of rubble-stone, faced with ashlar, 22 yards average width, a long slope to seaward, and the parapet wall rises seven yards above high water. The whole cost of the works was 3224*l*., three-fourths of which were contributed by Government. The harbour is very confined, being less than half an acre in extent, and owing to their being no beaching place for the swell to expend itself, is very uneasy. In the year 1839, in one night, 20 boats, lying inside, were dashed to pieces by a sudden storm coming on. This is considered one of the best fishing stations on the coast; but in consequence of the smallness of the harbour, there are only 33 boats, employing 150 men. Clyth has a small but substantial pier, and 48 boats; Whaligoe 25 boats, but no protection.

WICK.

See plan, p. 376.

App. Ev. p. 363.

See section, p. 712.

8 Vic. c. 52.

WICK OR PULTENEY TOWN harbour was erected by the British Fishery Society, a company of public-spirited gentlemen, united in 1807 for the encouragement of the fisheries. The old harbour consists in the outlet of the Water of Wick, the banks of which have been partially quayed, but the channel is much filled up with sand and stones. The new or Pulteney Town harbours were designed by Telford. The inner harbour was begun in 1807 and finished in 1811, at a cost of 16,000*l*.; the outer, or south harbour, was completed between the years 1824 and 1829, at a cost of 21,000*l*.; the whole of which, with the exception of 7500*l*. contributed by Government, was at the expense of the British Fishery Society. The area of the two harbours is 12 acres, the extent of quays 830 yards, and the width of entrance 80 feet; both harbours dry at low water, and have a depth of 10 feet at the entrance at high-water spring tides; they are defended from the heavy easterly gales by a massive breakwater pier, built by Mr. Bremner, C.E., having the foundation course of blocks of stone from 15 to 30 tons weight. It has a slope to seaward of 1 to 1, with a parapet rising 20 feet above high water; yet such is the force of the sea in easterly gales, that the waves roll up the slope and over the wall, and the spray is carried a hundred yards across the harbour. The arrivals and sailings in cargo for 1846 were, 1081 vessels of 63,610 tons; of these 266 vessels were to and from the colonies and foreign. The harbour revenue was 1709*l*., and the debt 5828*l*.

App. Ev. p. 363.

App. No. 286.

Wick is the chief station of the herring fishery on this part of the coast; it has 338 boats belonging to it, and in the season as many as 800 boats, employing 4000 men and boys, are said to fish from it. There is, however, great want of accommodation for this number of boats, and especially a want of a low-water harbour; and to remedy this inconvenience it is proposed to run out a pier from the Salmon Rock into 13 feet depth at low water, and eventually to connect it with the present breakwater, and thus form a harbour of 8 acres area. Either this or some other measure should immediately be adopted: the harbour in its present state is far from affording proper accommodation to the fishing boats that have been induced to resort hither: both the outer and inner harbour are much choked up with sand; no proper dredging has ever been applied to them; large stones, which might easily be removed, lie in the fairway; the south pier end projects beyond the harbour entrance, and catches the sand brought down by the stream; and, at the time of our visit, there were no cranes on the quays, nor any symptoms that betokened efficient superintendence.

BROADHAVEN.

BROADHAVEN, with its deep water and many small indentations, affords good shelter, and especially so in Utrigoe creek, where the water is always smooth; it has, however, a rock at its entrance. This bay, which is capable of improvement, is much frequented by the enterprising Buckie fishermen, who are able to pass in and out with their large boats in any weather

SCOTLAND.

Admiralty Chart, 1845.

and at all times of tide. Staxigoe Creek is sheltered by two long points of rock, and has a stone quay: it is used by small coasting-vessels in fine weather, and has 38 fishing-boats belonging to it, employing 180 men.

ACKERGILL.

Ackergill, in Sinclair Bay, sheltered from south-easterly gales by Noss Head, is valuable as a landing-place, when the steamer cannot attempt to land at Wick; and a low-water pier erected here would afford great accommodation to passengers and for the shipment of cattle, as well as to the numerous vessels that use this bay as a stopping place till the westerly wind moderates enough to allow them to make their passage through Pentland Firth.

App. Ev. p. 366.

Sinclair Bay, from the low nature of its shore and the similarity of Noss and Duncansby Heads, has often been mistaken for the entrance of the Pentland Firth, and many wrecks have taken place in consequence; but the site for a lighthouse has now been marked out at Noss Head which it may be hoped will be speedily erected and serve as a remedy; yet for more than a quarter of a century of profound peace, 70 miles of this coast, from Tarbet Ness to Pentland Skerries, have been left without a single light, while the traffic along it, from official returns, appears to be 4861 loaded vessels of 706,866 tons annually. It will be seen by the Reports of the Inspecting Officer of Coast-Guard, printed in the Appendix, that great irregularities with respect to pilotage, &c., occur in this neighbourhood, showing very forcibly the want of some controlling Board specially appointed to watch over such proceedings.

Lighthouse Rep. 1846.

App. No. 284.

KEISS.

Keiss, in a very exposed situation, is sheltered by a breakwater pier, originally built by Mr. Bremner, C.E., in 1820, but left unfinished till 1833, when it was completed at an expense of 1600*l*., two-thirds of which were paid by the Fishery Board. The area of the outer and inner harbours is about three-quarters of an acre, the width of entrance 35 feet, and there is a depth of 8 feet at high water at the pier-heads. It is the head-quarters of 46 fishing-boats. Freswick Bay is commonly used by vessels bound to the westward, when waiting for the tide, and here they will find good anchorage in off-shore winds.

Fishery Rep. 1833.

PENTLAND FIRTH.

Pentland Firth, the strait between Caithness and the Orkneys, well known for the rapidity of its tides, is about 17 miles long by 7 wide. It is well lighted at its eastern end by two fixed lights on the Pentland Skerries, first exhibited in 1794, and among the five earliest public lighthouses built in Scotland: the high light is 170 feet above high water, and is visible in clear weather to the distance of 6 leagues. The western end of the Firth is marked by a single fixed light on Dunnet Head, placed, in 1831, at a height of 346 feet above the sea; visible 8 leagues in clear weather, but in the foggy weather that usually prevails in these seas, it is, from its great elevation, often obscured by mist. According to the official returns, it appears that 4178 vessels carrying cargo, of 664,064 tons, passed through the Firth in year 1846; this number is exclusive of vessels in ballast, passenger steamers, ships of war, revenue cruisers, and all under 15 tons burthen.

Lighthouse Rep. 1846.

The rocks and dangers in this strait, known by the names of the Boars of Duncansby, the Merry Men of Mey, and the Swalchie of Stroma, are sufficiently formidable; but with good charts, good lights, and good beacons, which the mariner is entitled to expect, and especially with a well-organized body of efficient pilots acting under proper control (which is far from being the case at present), we should hear far less of the difficulties and dangers of navigating the Pentland Firth.

App No. 284.

ORKNEY ISLES.

The **Orkney Islands** contain numerous natural bays and harbours. Long Hope in Hoy, and Widewall in South Ronaldsha, are well known for the refuge they afford in stormy weather to vessels passing through the Pentland Firth. The tidal harbour of Stromness is especially valuable, as it is the only port north of Aberdeen where vessels can go to for repairs in case of damage, there being a patent slip laid down capable of taking on vessels of 500 tons burthen. Here also water and supplies of all sorts may be obtained; and it is annually visited by Greenland whalers and Hudson's Bay ships, besides 580 vessels seeking shelter, which called here during the last year. The harbour would be doubly valuable were there proper lights to lead up to the anchorage.*

KIRKWALL.

Kirkwall is sheltered from the northward by a pier extending 120 yards from the shore, with a return head of 33 yards pointing to the north-west, built prior to 1820, at a cost of 3944*l*., one-half of which was paid on the part of the public out of the balances of the Forfeited Estates. It has a fixed light at the pier end. A harbour trust was constituted in 1828, with power to enlarge the harbour and levy dues: its income last year was 168*l*., and its debt 710*l*. The arrivals and sailings were 313 loaded vessels of 35,197 tons, of which 10 vessels were to or from the colonies and foreign; custom dues 962*l*. It is much to be regretted that rubbish and ballast are thrown into the harbour at Stromness, and, it is to be feared, at all the other harbours in the Orkneys, and no one appears to have authority to prevent it; a summary mode of dealing with the offenders must be granted by the Legislature as the only safeguard against the ruin of our harbours and the only efficient remedy for this destructive practice.

9. Geo. IV., c. 58.

App. No. 478.

SHETLAND ISLES.

The **Shetland Isles**, like the Orkneys, with their numberless Vows and sounds, have many natural harbours. The most frequented is that of Lerwick, in Brassa Sound, a capacious roadstead, offering ample shelter to vessels proceeding to or from the Russian ports in the White Sea, Norway, Iceland, or the north of Europe generally. The arrivals and sailings in 1846 were

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* It is understood that leading lights are to be erected on Guernsey.

SCOTLAND.

Fishery Rep. 1846.

App. No. 293.

284 loaded vessels, of 30,527 tons; and among them, it is worthy of remark, were two Shetland vessels, which, for the first time, proceeded to Davis's Straits for the prosecution of the cod fishery, and with great success, having taken about 30,000 fish. It appears in evidence that there is no public wharf or landing place, no local lights, buoys, or beacons, although such would be very useful. It is further stated, that the inhabitants of Lerwick have projected their buildings into the Sound, wherever it suited their convenience.

App. No. 494.

The chief employment of the hardy natives of these two groups of islands, and their great resource against famine, consists in the fisheries; the district of Lerwick alone has 524 boats, employing 1744 men; in addition, there is the western district of Walls, with 263 boats, and the northern of Unst, with 144 boats, making a total of 931 boats, employing 3927 men and boys in the Shetland Isles. The north and south groups of the Orkneys, in like manner, have respectively 261 and 434 boats, or an aggregate of 695 boats, manned by 3000 men and boys, and occupying numerous persons in the whole business connected with the process of catching and curing fish. This is a branch of trade deserving every encouragement, yet no landing accommodation of any sort exists, and the Shetlander must only look for help to the sheltered bays and creeks with which nature has so bountifully supplied him.

PACKET STATIONS.

The mail communication with the Orkneys is from Huna, two miles to the westward of Duncansby Head, to the village of Burwick, in South Ronaldsha, a distance of about seven miles across the Pentland Firth; letters and passengers are conveyed in an open boat, and it is remarkable, that neither at Huna, in Caithness, nor at Burwick, in Orkney, is there one stone laid upon another at these packet stations for the protection of the mail boats or the safety of passengers. The boats are laid upon the open beach, and the act of landing from them with Her Majesty's mails is often attended with more hazard than the navigation while crossing the Pentland Firth. The population of the Orkneys is about 67,000; but, independent of their accommodation, the shipping interest of the country is put to serious inconvenience by windbound vessels detained at Long Hope, Stromness, and elsewhere in the Orkneys, the masters of which cannot communicate with their owners or agents on the mainland, from the ill-appointed state of these ferries.

At Burwick the mail is taken up by a "runner," and carried across South Ronaldsha to the ferry of Water Sound; he then proceeds across the island of Barra to the ferry of Holm Sound, and from thence, by land, again to Kirkwall. These three post-packet ferries are all crossed by open boats, and the landing places are on the open beach.

THURSO.

THURSO HARBOUR is formed by the outlet of the river which falls into the sea at the extreme south-eastern angle of Thurso Bay; it is left in a state of nature, and has neither pier nor wharf. The rise of tide is 13 feet on springs, at which time there is a depth of 15 feet over the bar. Immediately to the westward of the outfall, the water deepens suddenly to 14 feet, so that if a channel were once dredged to the edge of this spot, it is probable that the daily scour of the tide, assisted by the land-floods, would keep the entrance free from a bar. The arrivals last year were 119 vessels, of 5809 tons.

See plan, p. 376.

App. No. 297.

Lighthouse Rep. 1846.

On the western side of Thurso Bay a pier is now being erected at Scrabster, which will have a depth at its head of six feet at low water, and 19 feet at high-water spring tides, and thus afford a convenient shipping place for cattle and the produce of the surrounding district, and for supplying wind-bound vessels in the bay with provisions and water; the latter requisite is abundant and easily might be, and ought to be, led down to the pier. Owing to the vicinity of this roadstead to the Pentland Firth, and the shelter it affords in the prevailing westerly winds, the anchorage is of great value, and the holding-ground is good, if proper care be taken to anchor within the line of Little Head and the Old Palace. As many as 57 vessels have been seen here at one time, and the arrivals average about 500 annually; and when we consider the usually boisterous weather and rapid tides of the Firth, and the number of vessels that pass through it, officially reported at 4178 loaded vessels of 664,064 tons annually, not including ships of war, revenue cruizers, ships in ballast, or fishing vessels, the value of this roadstead is much increased. Were a light placed on Little Head, it would be a great benefit and safeguard to shipping, and materially add to the usefulness of the anchorage.

HAM.

Fishery Rep. 1846.

HAM, Castlehill, and Sandside, have small artificial harbours, built at the expense of their respective proprietors. The arrivals at Castlehill last year were 104 vessels of 4909 tons. The Kyles of Tongue, and Durness, and Loch Eribol, are deep, natural inlets, the last-mentioned affording good anchorage; on the western side of its entrance is the small fishery pier of Rispond. The fishery districts of Thurso and Tongue, extending from Duncansby Head to Cape Wrath, a distance of 60 miles of stormy coast, have respectively 177 and 136 boats, employing 1370 men, but throughout there is an absolute want of piers and landing places. At Portskerry, where there are 26 boats, and at Talmine, such erections would be of great service, and be hailed by the fishermen as an invaluable boon. The noble proprietor of this district has recently given prizes to encourage the men to persevere in their calling, but the most beneficial and most permanent encouragement would be to form harbours to which the toil-worn fishermen could run their boats with confidence in time of need.

CAPE WRATH.

CAPE WRATH, at the north-western extreme of the mainland of Scotland, is marked by a revolving light, placed, in 1828, at an elevation of 400 feet above the sea. The deeply indented west coast, which extends from Cape Wrath to Loch Linnhe, at the south-western entrance into the Caledonian Canal, abounds in natural harbours and creeks, which, at some future day, as population and civilization advance, will become of great value; at present they are the resort of numerous fishermen, the produce of whose fishing is almost their only support, and who, from want of landing places, are obliged to haul their boats up on the beach, or on the rocks for safety. The three districts Ullapool in Loch Broom, Loch Shildaig, and Loch Carron, have respectively 446, 183, and 595 boats, employing 4660 men and boys in the herring and line fishery. Clachnessie, Culkeen, Achnecharn, Reef, and Acheldebuc, are large fishing villages, and sadly in want of shelter.

HEBRIDES.

HEBRIDES.—This group of islands, comprising the Lewis, Harris, Uist, Berbecula and Barra, and reaching 112 miles from north-east to south-west, forms the western limit of the passage known by the name of the Great and Little Minch, a track much frequented by shipping, 2887 loaded vessels, of 364,001 tons having passed through it during the last year. This extent of coast from Cape Wrath to Barra, a distance of 140 miles, has only one intervening light at Island Glass, erected as early as 1789. Barra Head Light, at the southern end of the group, at a distance of 75 miles from the latter, has the undesirable distinction of standing at a greater elevation than any other light in the United Kingdom, namely, at 680 feet above the level of the sea. It was first lighted in 1833.

Lighthouse Rep. 1846.

STORNAWAY.

STORNAWAY lies in a deep loch or bay on the east coast of the Island of Lewis, and has an area of 150 acres of anchorage, sheltered from all winds, in a general depth of from 4 to 5 fathoms water, on a bottom of sand and mud. Here are about 600 yards of quay wall; and a building slip; a patent slip for vessels of 800 tons is being laid down; a low-water pier is in the course of erection, at the expense of the proprietor, and it is stated that the inner harbour will be deepened by dredging. The arrivals and sailings last year were, 218 vessels of 12,972 tons; the customs dues 1009*l*. In addition to these, 220 vessels of all nations, either wind-bound or seeking shelter, anchored at Stornaway, on their passage through the Minch. There is a great want of a harbour light.

See plan, p. 513.

App. No. 299.

CALLICOT.

At CALLICOT, near the Butt of Lewis, and at Carnish, fishery piers were built in 1835, at a cost respectively of 1645*l*. and 1810*l*., two-thirds of which sums were contributed by the Fishery Board. In the whole district of the Hebrides there are 634 boats, employing 3726 men, but there are no other fishing piers. The want of such accommodation is much felt at Skegasta, for which place the fishermen often run when they cannot approach the harbour of Callicot; at Voltos, at the entrance of Loch Roag, the principal fishing station on the west side of Lewis; at West Loch Tarbert in Harris, and in Barra.

SKERRIEVORE.

About 12 miles to the south-westward of the Island of Tiree, is the dangerous reef of Skerrievore, on which a lighthouse has recently been erected. The foundation stone of the building was laid in July, 1840, and the light first exhibited in October, 1845. It is intermittent, and stands at 150 feet above the sea. At Hynish Point, in Tiree, it was found necessary to construct a small pier in connexion with the work-yard established for the building of this lighthouse. Since the completion of the works, a small tide dock, with boom-gates and a scouring basin, have been constructed here for the use of the tender which furnishes the lighthouse with supplies. The erection of this lighthouse in this important yet very exposed situation is highly creditable to the public spirit and liberality of the Commissioners of Northern Lights, and especially so to the skill of Mr. Alan Stevenson, engineer to the Board.

PORTREE.

PORTREE, the capital of the Isle of Skye, has a well-sheltered harbour, with good holding-ground, and a landing wharf or quay, erected in 1820, for 676*l*. The Kyle Rhea Ferry piers, to connect the island with the main, cost 1146*l*.; both these and the Portree Quay were built at the joint expense of the proprietor and the public. The sheltered and almost land-locked navigation of the Sound of Skye might be thrown open to our coasters by night, if the Kyle of Akin were lighted, as it easily might be.* Detailed plans of this harbour, of Tobermory, and of Stornoway, have just been published by the Hydrographic Office at the Admiralty.

TOBERMORY.

TOBERMORY, at the northern entrance of the Sound of Mull, is one of the most useful harbours in the Highlands, and of easy access, but the water is rather too deep, there being from 18 to 25 fathoms, except when very close in shore. The town was built in 1788, at the same time as Ullapool, by the British Fishery Company, as the site of a fishing establishment: it has a pier extending 100 yards from the shore, constructed in 1814, at a cost of 3110*l*., one-half of which was paid by the public; and a second landing jetty, erected in 1835, by the proprietor. The arrivals and sailings during the last year were, 425 loaded vessels of 29,783 tons; The harbour dues, however, are trifling, the whole income from this source being 16*l*.

App. No. 301.

The Sound of Mull, or the strait between the island and the main, is 15 miles long, by about two miles wide, and has good depth of water throughout. Since the erection of the light at Lismore, at its southern entrance, in 1833, the traffic through it has much increased, but a light is still wanted at Ardnamurchan, at its northern entrance, and a harbour light at Tobermory, besides some buoys and beacons (particularly on the New Rock), in order to bring out the true value of this passage, and to complete the anchorage as a harbour of refuge.

The site for a lighthouse has now been marked out at Ardnamurchan Point, but hitherto the approach to Tobermory and to the Sound of Mull, by night, has been almost barred. In this region of rapid tides, stormy seas, and long winter nights, the nearest light in coming from the westward is at Barra Head, distant 60 nautic miles; and the nearest in coming from the northward, through the intricate navigation of the Little Minch, is at Island Glass, full 85 miles distant.

FORT WILLIAM.

At FORT WILLIAM, near the head of Loch Eil, on its eastern shore, a protecting pier and landing place, 80 yards long, including the return head, was erected in 1832, at a cost of

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* It appears that a light is to be placed here.

SCOTLAND.

Admiralty Chart, 1847.

1660*l.*; smaller landing piers were also constructed in Kintra Bay, on the north side of Ardnamurchan, and at Salen, on Loch Sunart, at an expense of 1175*l.*; two-thirds of these sums were contributed by the Fishery Board. A small but dangerous rock, having only 9 feet water over it at low water, has recently been discovered in the usual anchorage in Cambusna Gaul Bay, in Loch Eil, midway between Maclean Rock buoy and the nearest shore; it should be well marked by a buoy, or be blasted away; the latter would be the safer plan.

At Corpach, a mile-and-a-half further north, is the sea-lock, which forms the south-western entrance into the Caledonian Canal; it is said to have 20 feet depth of water over the sill at high water of ordinary neap-tides. As before mentioned, the Caledonian Canal is again opened for traffic, and vessels are invited to make use of it in order to avoid the stormy passage through the Pentland Firth; yet Loch Eil, leading up to its south-western end, has neither lights nor buoys to mark the approach. A light is wanted at Corran Point at the The Narrows, and probably leading lights to avoid the rocks at the upper end of the Loch. Perches or buoys are required at Chlavoulin and Culchenna Spits, on the Corran Bank, and at least three buoys on the steep edge of the Lochy flat above Fort William.

OBAN.

App. No. 302.

See plan, p. 518.

OBAN, from its central position between the Caledonian and Crinan Canal, or rather between Glasgow, the Hebrides, and Inverness, has rapidly risen to be a port of great traffic. The bay is spacious and well sheltered, and affords 100 acres of good anchorage, in from 12 to 20 fathoms of water, which is rather too great a depth for small coasters. There are two quays at the town, at which vessels may discharge and take in cargo, one of which was improved and enlarged in 1836. The arrivals and sailings last year were 387 loaded vessels, of 21,657 tons, one-third of which were steamers; the harbour dues are very light, amounting only to 18*l.* a-year. The Skerrat rock and shoal, on the western side of the bay, have at length been properly buoyed. 130 boats are employed in the fishery between Oban and Fort William. The chief ferry of Mull is from Oban; it is four miles to the opposite isle of Kerrera, and thence seven miles to Achnacraig, in Mull.

CRINAN CANAL.

App. No. 481.

App. No. 303.

Cal. and Crinan Canals, Rep. p. ix.

The CRINAN CANAL was intended to afford water communication between the Firth of Clyde and the Western Ocean, and thus avoid the circuitous and often difficult passage of 80 miles round the Mull of Kintyre. As early as the year 1771, James Watt reported on the subject of a canal at Crinan and at Tarbert, and recommended that, if the former were made, it should be 10 feet deep, and have 14 locks, of 8 feet rise, 20 feet in width, and 72 feet in length; nothing further, however, appears to have been done at that time. The project was revived in 1793, when a joint stock company was formed, under an Act of Parliament, to carry out a plan by Rennie, and the canal was opened for traffic on the 18th July, 1801. The original estimate for the work was 63,678*l.*, but the money subscribed by the proprietors, and first expended upon the canal, amounted to 108,000*l.*: owing to unexpected difficulties, this sum proved to be quite insufficient for its completion, and subsequent advances were made by Government, at different periods, under the authority of Parliament, to the extent of about 75,000*l.* To secure this sum, the canal was transferred on mortgage to the Lords of the Treasury, who placed the whole under the superintendence of the Commissioners for the Caledonian Canal, and under their direction it has subsequently remained. The canal is about 9 miles long, and has 15 locks, 13 of which are 96 feet long, 24 feet wide, and formed for 12 feet, but maintained at 10 feet deep; the remaining two are 108 feet long and 27 feet wide. The summit level is 58 feet above high water in Loch Fyne, and this is attained by means of 8 locks, in ascending from Loch Gilphead or Ardrishaig, at its south-east end; the descent to Loch Crinan, at its north-west end, is by 7 locks. The canal can be navigated by vessels drawing 9½ feet water; but, owing to the heavy dues, and delay by lockage, it is less frequented by fishing vessels and coasters, to which it would otherwise be so beneficial, than with more moderate dues it would be. There is a passenger traffic to meet the steamers on either side, which has increased from 2400, in 1820, to 17 527 in 1846; the number of vessels that passed through the canal last year was 1449 of 35,552 tons, besides 573 boats; and the revenue was 2526*l.*, which is sufficient, since the great repair of 1817, to pay the expense of maintenance, and to admit of improvements. A Committee of the House of Commons reported in 1839 that, "from the best information they could obtain, it appeared that it is to the originally defective construction and insufficient dimensions of this canal that its failure must be attributed." That it has been a failure in a financial point of view is manifest, and that it was planned on so small a scale is extremely to be regretted, but that it has conferred very considerable benefits on the coasts in its immediate neighbourhood, and on the western islands and highlands of Scotland, and materially aided in the recent rapid development of the resources of these districts and in the spread of civilization, there cannot be the least doubt, and works that have assisted in such a cause can hardly be considered to have entirely failed, or the public money bestowed upon them to have been ill spent. It appears from the Reports of Mr. Walker, and of Mr. Thompson, resident engineer, that the sum of 9000*l.* ought to have been expended in 1839, in order to carry out improvements, and to put the canal in a fair state of repair. As a large outlay has just been made on the Caledonian Canal, it may be found good policy to place the Crinan on a similar footing as to efficiency, as it must be considered a material link in the chain of communication which connects Glasgow and the ports on the Clyde with Inverness and the Highlands.

ARDRISHAIG.

In conjunction with the restoration of the canal, it will be necessary to take into account the state of the harbours at either end and the approaches to them, which have never yet been sufficiently attended to. ARDRISHAIG, at the southern entrance, has become the most important steamboat station on Loch Fyne; independent of coasters and vessels intending to pass through the canal, more than one steamer arrives and departs daily, carrying passengers, goods, and large quantities of cattle, and for this traffic the wharfage is loudly complained of as very insufficient. The south side of the harbour is sheltered by a stone pier, which extends off shore 170 yards in an easterly direction, with a harbour light at the pier-head; and on the north side is a steam-boat pier, about 45 yards long, built in 1836. The arrivals in 1846 were 527 vessels of 51,380 tons, and about as many sailings: 37,633 passengers landed and embarked by the Loch Fyne and Crinan steamers; and 30,000 sheep and 1400 head of cattle were shipped: the harbour revenue was 269*l.*, and the amount of debt contracted in building the steam-boat pier 1670*l.* Ardrishaig is also the resort in the season of numerous boats engaged in the herring fishery, and these, as well as the above-mentioned traffic, would be greatly benefited by the pier being lengthened and the harbour deepened.

App. No. 304.

CRINAN, in like manner, has lately become a station of considerable importance for steamers to and from the Western Highlands, and is equally deficient in protection and wharfage. A covering pier is much wanted, as well as repairs to the sea lock, and deepening the entrance thereto. The arrivals in 1846 were 129 vessels of 14,089 tons, and accommodation for this traffic, and shelter for vessels entering or departing from the canal, are much required. A harbour light, too, is absolutely essential, and a corresponding small light at Dorresmore, at the south point of Craignish. The necessity for lighting and protecting this harbour is the more evident from there being no well-constructed harbour on the western side of the mainland of Argyll from the Mull of Kintyre to Oban, a distance of 100 miles.

CRINAN.

App. No. 303.

JURA has two harbours on its eastern side, named Lowlandman's Bay and Small Isles; the latter has a small pier, built in 1814, at a cost of 746*l.*, half of which was paid by Government. White Farlane Bay, on the south side, opposite Port Askaig, in the Sound of Islay, affords good shelter by anchoring close in-shore out of the eddy tide.

JURA.

ISLAY comprises Port Askaig, on the shore of the Sound of Islay; Bowmore, on the eastern side of Loch-in-daal; and Port Ellen and Port Charlotte on the south-east coast, opposite the Isle of Gigha: the three first-named small harbours have piers. At Port Ellen the quay was raised, and a pier, 30 yards long, built in 1832, for the sum of 763*l.*, at the joint expense of the proprietor and the public. It is proposed to extend the pier into a depth of 12 feet water, and to finish it with a return head. Port Ellen has also the advantage of a harbour light; but there is no light in the Sound of Islay.

ISLAY.

The arrivals during the past year were, 186 vessels of 8759 tons, carrying cargo, independent of the passage steamers from Glasgow and the ports of the Clyde. The exports from Islay are stated at 70,000 tons annually, and a much increased traffic is expected in limestone. Off the south-west point of the island, at the Rhinns of Islay, an intermittent light was placed in 1825, at an elevation of 150 feet above the sea, visible 6 leagues in clear weather. It is nearly midway between the light at the Mull of Kintyre and that at Skerrievore, or about 40 miles from each. Since the erection of this lighthouse, Loch-in-daal is much more frequented as a harbour of refuge by vessels using the North Channel to or from the Clyde and Liverpool; but it still wants a harbour light, and buoys and beacons to mark the projecting spits off Bowmore, as well as some efficient control to prevent vessels throwing their ballast out into the harbour, which it appears, from the statement of Lloyd's agent, is an affair of common occurrence. Islay has 206 boats, manned by 606 men and boys, employed in the fisheries; of these 84 boats belong to Portnahaven, 30 to Port Charlotte, and 26 to Port Ellen.

App. No. 482.

App. No. 479.

The fixed light at the Mull of Kintyre, at the south-western entrance of the peninsula of Argyll, first shown in 1787, was one of the earliest, if not the first public coast-light, exhibited in Scotland. It stands at an elevation of 297 feet above the sea, and occupies a most important position as the guide into the Irish Sea by the North Channel (here only 10 miles wide), and as the turning point for vessels bound into the Clyde. From Parliamentary papers, it appears that 6463 loaded vessels, of 867,596 tons, paid dues for passing this light in 1846. It is, however, wanting in three essential conditions of a well-placed light: it stands at too great an elevation above the sea, and is, therefore, often obscured; it does not cover the outer dangers, namely, Patterson's Rock, which lies some distance to the eastward of Sanda; nor is it available for vessels bound up the Clyde. To light this channel in the most useful manner, the Mull light ought to be removed to Sanda (or an additional light be placed on this island), and a compensating light erected on Rathlin Island, off the north coast of Ireland. This latter light would also be a great benefit to the traffic from Sligo and Londonderry to Glasgow. A conspicuous beacon likewise should be erected on Patterson's Rock.*

MULL OF KINTYRE.

Lighthouse Rep. 1846.

CAMPBELLTOWN LOCH, or bay, is well known as a natural harbour of refuge, affording a large area of secure anchorage, much frequented by the trade of the Clyde, more than 500 vessels having sought shelter here during the last year. There is a good harbour light, and the necessary buoys and beacons to mark the dangers have recently been placed, but a coast light is still wanted on Devaar Isle to lead up to the Bay.* The tidal harbour at the head of the loch lies between two stone piers, extending about 200 yards from the shore: it is said to have a depth of 13 feet at the quays at high water. The number of vessels belonging to the port, two of which are steamers, is 28, of 2039 tons. The arrivals in 1846, exclusive of those seeking shelter and passenger steamers, were, 442 vessels of 12,855 tons: the harbour dues were leased for 191*l.*, and the debt was 4034*l.* The dues are levied under a charter of King James VI., granted in 1700, and the harbour affairs are managed by the council of the burgh. In 1844 the law expenses, on account of dues disputed, amounted to 400*l.*, or three times the then whole revenue of the port; and the Parliamentary and legal expenses attendant on obtaining a new

CAMPBELLTOWN.

See plan, p. 615.

App. No. 305.

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* It appears that a light is about to be placed on Sanda, and also on Devaar.

SCOTLAND.

Act in 1846 were 2600*l.*, or more than thirteen times the revenue. Campbelltown is the head quarters of an extensive fishing district, including Islay, and employs 583 boats, manned by 1836 men and boys; of these, 130 herring-boats belong to Campbelltown alone.

SKIPNESS.

At SKIPNESS, a projecting point at the north end of Kilbrannan Sound, a fishing-pier extending 60 yards off-shore in an easterly direction, with a return head of 32 yards to the northward, was erected in 1839, at a cost of 2997*l.*, two-thirds of which were contributed by the Fishery Board on the part of the public. The pier has 5 feet depth at low water, and is a great accommodation to the 60 boats belonging to the place, and to others which frequent the favourite fishing-ground of Kilbrannan Sound, as well as to the steam-boats passing along the coast. A pier at Carradale would also be a great benefit.

TARBERT.

TARBERT, East and West, are two sea lochs approaching each other within a mile, on opposite sides of the great southern peninsula of Argyllshire, at about midway between the Mull of Kintyre and the head of Loch Fyne, near Inverary, thus nearly bisecting this distance of 80 miles. West Tarbert extends in almost a straight line south-westward, 11 miles in length, by about three-quarters of a mile mean breadth It has a quay with 12 feet at low-water spring tides, from which a steamer plies to Islay twice a-week in summer and once a-week in winter. At the western entrance of the loch is the island of Trien, forming the harbour of Ardpatrick, in which the revenue cruizers will be found safely riding when the heaviest westerly gales blow in the Sound of Jura.

App. No. 482.

App. No. 491.

The East Loch is barely one mile in length by less than half a mile in width. Yet, small as it is, this is the head-quarters of the Loch Fyne herring fishery; and in the season, as many as 700 vessels and boats, employing 2000 men, have been seen at one time in this singular and almost land-locked natural harbour. A convenient quay, with a bridge and road of approach, was built here in 1812, at a cost of 1728*l.*, at the joint expense of the proprietor and the Government; and more recently an additional quay has been erected for the accommodation of the steam traffic, which has greatly increased, 800 arrivals having taken place during the past year, besides 126 sailing vessels, of 2787 tons. The revenue of the harbour is 126*l.*

ARGYLL CANAL.

App No. 481.

App. No. 482.

App. No. 483.

The near approach of East and West Tarbert lochs naturally turned attention towards water communication between them. As early as 1772 James Watt examined the locality with this view, and, in his Report to the Board of "Annexed Estates," printed in the Appendix, gives an estimate of the expense of a canal 7 feet and 10 feet deep, and of a through cut 12 feet and 16 feet deep at neap tides. The last mentioned was to cost 120,790*l.*; nothing further, however, was done at that time. Twenty years later the Crinan Canal was made, and the subject of the Tarbert communication was allowed to slumber. The recent rapid extension of steam navigation, the opening out of the resources of Islay, the insufficiency of the Crinan as a ship canal, and the desire to avoid the often tedious and turbulent passage round the Mull of Kintyre, have again directed attention to the isthmus of Tarbert, and in 1845 the spirited merchants of Glasgow and others caused a fresh survey of the line to be made, and obtained an Act of Parliament for carrying the work into effect. The estimate of Mr. Gibb, civil engineer, for the whole expense connected with cutting a canal 56 feet wide and 18 feet deep below low water, with two regulating locks, is 147,950*l.* During the present year Government have caused the proposed scheme to be inquired into, and the Reports of the officers, Captain Sir E. Belcher, R.N., and Lieut. Col. Yule, R.E., pointing out the many advantages, both in a mercantile and military point of view, will be found in the Appendix. There may be some difficulty arising from the difference of the levels of the tide on the east and west sides of the peninsula, said to amount at times to 12 feet, which it is proposed to guard against by placing a pair of flood-gates at each end; but it is to be hoped, when the work comes to be carried out, no practical obstacle will be found to making a through open cut, and that it will be wide enough and deep enough to admit, at all times of tide, the largest war steamer, or the heaviest merchant vessel than either can now, or will in future, ascend the Clyde to Glasgow Quay.

In the eastern part of Scotland large sums of public money have been expended upon roads and bridges, and the testimony of all observant persons is unanimous as to the advance in civilization, in comfort, and in wealth, that has immediately followed in the wake of such improvements. But in the western district of Scotland, and especially in the county of Argyll, the rivers, lakes, and sea are now the means of intercourse; and the very barrier which mainly prevented communication in the days of our fathers has proved to be the great highway in our own. Steam-boats are at once the heralds and the cause of every kind of improvement in the Highlands and islands of Scotland; nor is it any exaggeration to say, that they have raised the value of land in Argyllshire fully 20 per cent. during the last 20 years; independent, then, of the advantages of such a communication in a military point of view, every facility that can be given to uninterrupted intercourse, and thereby to the spread of civilization, cannot but be hailed as a national benefit.

LOCHGILPHEAD.

App. No. 309.

At LOCHGILPHEAD is a small quay, built by the proprietor of the adjoining property in 1813, at an expense of 500*l.*; it is quite sheltered, has 6 feet water at high tides, and is useful, to a limited extent, to the fishermen and other inhabitants of this thriving village. The arrivals last year were 49 vessels of 343 tons. The Glasgow and Inverary steamers call at Ardrishaig pier daily; and there is constant communication to Oban by the Crinan Canal. The tolls levied at the quay are trifling, only amounting to 7*l.* a-year. If there were authority to take dues to sufficient amount, or could funds otherwise be raised, it would not be difficult to straighten and deepen the river bed so as to make the quay accessible to steamers at half tide.

SCOTLAND.

INVERARY.

Inverary, near the head of Loch Fyne, has a small pier, reaching off-shore 90 yards to the north-east, with a short return head to the north-west; it was extended into 5 feet depth at low water, and an outer landing slip, built in 1836, at a cost of 1435*l*., two-thirds of which sum were paid by the Fishery Board. The dues, which amounted to 73*l*. in 1846, are levied by virtue of a charter of Charles I., dated 1680. See plan, p. 518.

The small ferry pier at St. Catherine's, on the south side of the loch, opposite Inverary, is an example of great convenience obtained at the moderate expense of 166*l*., half of which was paid by the public. Many such piers would be highly serviceable in the county of Argyll, intersected as it is by arms of the sea in various directions.

LOCH FYNE.

Loch Fyne has been, from time immemorial, noted for its herrings, which are said to be of a superior quality to any found in the western seas. The fishing commonly begins in June, and continues till the end of September, during which period the loch is frequented by vast shoals of herrings. The number of boats belonging to the district between Inverary and Tarbert, last year, was 590, employing 1770 men and boys; but it is probable that many more were employed in the fishery. The number of herrings caught was 20,400 barrels. A buoy has recently been placed off the rocks at Ardlamont Point, but a beacon is still wanted to mark the dangerous Otter Reef, which extends half way across Loch Fyne. Fishery Rep., 1846.

ARRAN.

Arran comprises the harbours of Lamlash, Brodick, Corrie, and Loch Ranza. Lamlash, sheltered by the Holy Isle, is a spacious natural harbour, much frequented by the outward-bound trade of the Clyde in strong westerly winds. The Pladda Lights, off the south-east point of Arran, are a good general direction for this bay, but, as an anchorage of much resort, it wants a harbour light as well as the requisite buoys and beacons.* Here is a quay, built about 50 years since, out of the ruins of a former quay, which stood a few hundred yards to the southward. Arran has 96 boats, manned by 380 men, employed in the herring fishery; of these App. No. 494. 23 boats belong to Lamlash, 9 to Brodick, and 8 to Corrie. These three places have piers, but they are quite insufficient for the fisheries. Twelve boats belong to Loch Ranza and 9 to Whiting Bay, neither of which has any pier at all, but both stand much in need of one. The remainder of the boats are distributed round the west coast of the island facing Kilbrannan Sound.

ROTHESAY.

The harbour of **Rothesay** (at the head of a spacious, well-sheltered bay, affording excellent anchorage, well marked by the Toward revolving light) was first formed nearly a century ago by the erection of a pier, at a cost of 1200*l*. About 50 years since, a second pier was built, but was beaten down by the sea. In 1815, the magistrates and council resolved to improve the harbour, and obtained a plan and estimate from Messrs. Stevenson, C.E.; this plan being found too expensive, a modified plan was prepared and carried into execution in 1822, at a cost App. No. 313. of 6500*l*., one-third of which was raised by subscription, and two-thirds borrowed from the Exchequer. This latter sum has been paid off, and the debt reduced to 1656*l*. The main pier of the harbour is a substantial erection of whinstone, extending 40 yards off-shore in a north-north-east direction, with a kant 100 yards long to the east-south-east, having 6 feet at See plan, p. 615. low water, and 16 feet at high-water spring tides at the pier head, which is well marked by a harbour light. In 1840 a patent slip was added to the harbour; there are also three building-slips belonging to the town. The arrivals last year were 234 sailing vessels, of 7254 tons, and 1927 steamers, by means of which daily communication is kept up with Glasgow, and the ports on the Clyde and Inverary, and with Oban and Inverness by the Crinan Canal. The harbour is governed by trustees, under an Act of Parliament obtained in 1831, and the revenue 1 & 2 Will. IV. c. 34. in 1846, arising from dues on shipping, levied under this Act, was 580*l*. Like other small harbours enclosed by piers, Rothesay suffers from a gradual accumulation of sand, which will entail a certain expense in dredging; but the remedy is effectual, and should not be too long delayed.

Rothesay is the head-quarters of an extensive fishing district, comprising the isles of Bute, Arran, and the Cumbraes, and employing 233 boats, manned by 832 men and boys. Piers for the convenience of fishermen are much wanted at St. Ryonald's Bay, and at Loch Riddan at the head of the Kyles of Bute.

DUMBARTON.

Dumbarton harbour is the channel of the river Leven, the outlet of Loch Lomond, in its tortuous course from the bridge to its junction with the Clyde. The face of the town is lined with quays, which have a depth of 10 feet at high-water spring tides. There is a graving-dock and several building-slips. It appears that, in virtue of old charters, confirmed by James VI. in See plan, p. 615. 1609, and ratified by Parliament in 1641, Dumbarton has a right of exemption from River Clyde dues, which, since the high rates levied by the trustees, and the recent improvements in the river, has become a privilege of some value. Attempts were made to do away with this right in 1825 and in 1840, but they failed; yet the law and Parliamentary expenses connected App. No. 316. with the defence of their privileges against a rich and powerful trust cost the burgh more than a year's harbour revenue. The arrivals in 1846 were 63 sailing-vessels of 2438 tons, and the harbour income 147*l*. There is no debt. The Leven is the outlet of Loch Lomond, to which lake the river could with comparative ease be made navigable if it were considered necessary.

GLASGOW.

Glasgow.—In the First Report of this Commission, it was stated that we had confined our inquiries to a few specific cases bearing on the general question of the necessity of some Government control over the whole of the harbours and tidal waters of the United Kingdom; and in selecting as examples the Clyde and Tay in Scotland, the Report brought prominently forward

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* A buoy has recently been placed on the Fullarton Rock, in the south channel.

SCOTLAND. — GLASGOW.

the improvement that had been made in these rivers, by the use of the steam-dredge and the removal of fords, awarded full praise to the sound principles acted upon and to the enterprise that had been evinced, and briefly adverted to those points which manifested a want of control for the public good.

This forbearance on the part of the Commission has been used as an argument by the Clyde trustees to prove that no Government control was necessary, and that such a recommendation, as far as the Clyde was concerned, was unjust and uncalled for. It becomes our duty, then, however ungrateful the task, to examine the question a little more in detail, yet only so far as to show that the management of the Clyde trust has not been such as to afford the slightest pretence for exempting the port of Glasgow from the general control that we have considered it our duty to recommend for the preservation of all the harbours of the United Kingdom.

App. C. No. 337. It appears from Parliamentary Papers, that since the year 1770, the gross harbour dues at Glasgow, levied on shipping and on goods borne by shipping, have been 898,280*l.* In addition to this amount, the Clyde trustees, at the close of the year 1846, had incurred a debt of 380,000*l.*; they have had the disposal, therefore, of 1,278,000*l.* on the harbour and river.

The question naturally arises, what results have been obtained from the expenditure of this large sum of money? We find that the harbour of Glasgow has been deepened on an average 14 feet, by a width of about 70 yards, for a length of 1100 yards. It has been partly faced with stone quays on both sides, the total length of which is 2400 yards, and the requisite sheds and cranes have been erected.

App. C. Ev. p. 419. By means of parallel dykes and dredging, a channel of 70 yards wide in the centre of the river has been deepened on an average 12 feet, over a distance of 2¾ miles; a channel, 90 yards wide, has been deepened, on an average, 6 feet over a distance of 2½ miles; and a channel. 100 yards wide, has been deepened 6 feet for a distance 1¼ mile; the same width and depth of channel, 700 yards in length, has been cut through the Port-Glasgow bank; the Garmoyle bank has been cut through; a harbour has been made at Bowling; the river has been lighted and perched throughout; and the revenue, up to the 1st July, 1846, had reached 52,000*l.* The tonnage belonging to the port for the last year was 512 vessels of 134,603 tons; the arrivals, 14,319 vessels of 1,117,968 tons, of which 430 vessels were from the colonies or foreign, and the customs dues amounted to 634,305*l.*

Such is a general, and, it is believed, an impartial statement of the whole of the improvements in the Clyde, and, as fully acknowledged in our First Report, they are as great as in any other river in the United Kingdom. We need not here stop to inquire whether the same
App. No. 498. results might not have been obtained at about one-half the outlay.

If we look a little deeper than the surface, we shall find that some of these works are far from being efficiently executed, others of the utmost importance have been neglected, and some are yet to be begun. The harbour of Glasgow is still in a very unfinished state and inadequate to the trade of the city; the lower portion of it is only 60 yards wide, with a projecting point near its entrance that might have been easily removed, narrowing it to as little as 57 yards. The stone quays are so ill founded that they are giving way throughout their
App. C. Ev. p. 392. whole extent; a length of 125 yards, built only ten years since, on the south side, has with difficulty and at great expense been saved from falling into the stream. A weir is placed across the river at Stockwell Bridge, destroying the navigation for some miles upwards, and stopping the tidal flow, and the scour that would follow. Although the injury to the harbour and river from the weir was well known, a recent Act of Parliament has been obtained by the trustees to perpetuate this dam, by rebuilding it higher up the stream, where it will be almost equally prejudicial, while the expense of the work will involve the harbour funds, that should be applied
App. C. No. 347. to remove obstacles, to an extent of 9000*l.*, in spite of a protest against the legality of such a proceeding by one of the Clyde trustees.

This weir, or a similar one at Glasgow Bridge, has been condemned by all engineers, from Rennie, in 1799, down to the present time; it may be useful, however, to quote the last public evidence respecting it by the resident engineer, as it shows its value in a sanitary as well as in
App. Ev. p. 393. an engineering point of view. He says, in answer to a question, "My opinion is, that the weir has a very prejudicial effect on the property at Glasgow, in forcing the water upwards in freshes, so as to flood the houses; that it makes the harbour the stagnant cesspool of the city, the filth from which, by deposition, is the cause of unnecessary dredging in the harbour, as well as of noxious vapours for miles from the Broomielaw in summer time; and that so long as this nuisance exists, the tidal scouring power, both inward and outward, will be rendered unavailable for the upper reach of the Clyde." He adds, "It would be highly desirable and beneficial for the great interests of navigation, for the rights of property, and for the health of an extensive portion of the city of Glasgow, to remove it entirely."

The space between the bridges, that might be easily made invaluable to coasters for harbour purposes, still remains not deepened, and only partly quayed, although power to do both was
App. C. Ev. p. 396. obtained in 1840; yet the advice of Whidbey in 1824, the testimony of some of the trustees, of the resident engineer, of the harbour-masters, and of all sailors who have been examined or reported on the subject, is in favour of such a work, as one of the greatest improvements
App. No. 341. that could be made; instead of which this space remains little better than a timber-pond, whilst extreme inconvenience to shipping is daily felt from the want of it, and the harbour revenue in consequence suffers a loss of some thousands a-year.

The dock or tidal basin of Windmillcroft, close to the business part of the city, and most convenient to the shipping (the land for the making of which was purchased six years since at an expense of 43,196*l.*), recommended to be made by Rennie as early as 1807, and repeatedly urged on the trustees since that time by all those conversant with the wants of shipping, still remains unexecuted, while 1600*l.* a-year, the interest of the purchase money, has been for that time lost to the revenue.

App. C. No. 354.

There has been a much larger expenditure of 63,750*l.* in the purchase of land for docks at Stobcross, a mile below the city on the north side, to which the greater part of the shipping interest is opposed, and the works for which cannot be executed without involving the trust in an enormous debt. It further appears that this land was publicly sold in Glasgow in November, 1844, at 3*s.* per square yard, and purchased by the Clyde Trustees in September following, at 8*s.* 6*d.* the square yard.

App. Ev. p. 399.

Although, as before mentioned, the expenditure of the Clyde trust has exceeded a million and a quarter in the last 77 years, there is neither graving-dock, nor patent-slip, nor gridiron, nor any convenience for repairing shipping required by the trade of the port, and which ought to have been long ago provided by the Clyde trust; and although Glasgow is the trade metropolis of Scotland, if a vessel receives damage she must go to Greenock or Liverpool for repair. It should also be stated that the want of that accommodation was so much felt that, prior to applying to Parliament in 1840, a petition was presented to the trustees, praying for a graving-dock, signed by the principal ship-owners and leading merchants of Glasgow, but the request was disregarded.

A more frequent and more annoying cause of complaint, however, arises from want of quay accommodation. Vessels lie in tiers five and six abreast, and sometimes have to wait as many days, and to shift their places as many times, before they can get a berth to unload. From the evidence of the harbour-master, the same complaint has existed for the last twenty years, and yet no proper effort has been made by the trustees to remedy it. The only provision up to this time for a traffic of 15,000 vessels annually is 2400 yards of quayage, and even of this limited space a portion has been very often under repair, owing to the work being so ill executed at first, and thus not available for shipping.

Evidence on the Clyde Navigation Bill, 1840.

App. Ev. p. 414.

Besides the detention to trade, and the inconvenience arising from this crowded state of the harbour, losses by collision and damage to vessels are of frequent occurrence; 70 cases are recorded in two years. The captain of one of the fine steamers trading to Liverpool gave evidence that, owing to the narrowness of the river and the crowded state of the harbour, he "had many times been two hours in going less than two miles," and that, "at half tide there was no room to steer a large steamer, owing to the river being so narrow." Yet, with all this inconvenience to the trade, the shore dues are very high, and although the shipping dues are light, the whole amount of dues paid by the shipowner are higher than at Greenock, Ardrossan, Troon, or any other port along the western coast of Scotland.

App. C. Ev. p. 414.

App. C. No. 339.

Below the harbour, as before mentioned, the points that project into the channel have not been cut off; in some places the river is not more than from 50 to 60 yards in its whole width, and the navigable channel not as many feet in width, thus not only offering the most serious obstacles to navigation, but, as appears in evidence, causing the land-floods or freshes at times to raise the water in the neighbourhood of Glasgow 12 feet above the level of high water, from want of room for its outfall.

App. C. Ev. p. 400.

The parallel dykes just below the harbour are much out of repair, and cause damage by the stones falling into the river. Henderson's Quay on the south side, and Donald's Quay lower down on the north side (private quays) are both tumbling down into the stream. It was stated in evidence that individuals have been allowed to encroach upon and obtain possession of the alveus of the river, whereby the rights of the Crown have been sacrificed, and the trustees have in one instance paid 8000*l.* out of the river funds for permission to cut off the points of two of the jetties; these very jetties lying on the alveus of the Clyde, and having been built by their own engineer.

App. Ev. p. 418.

App. Ev. p. 415.

At Newshot Isle the southern and more direct channel of the river has been blocked up by dykes, thereby excluding, both on the flood and ebb, a large amount of tidal water; and in consequence of the loss of scour, entailing a heavy annual expense in dredging away the deposit off Bowling; the river also has been thus suddenly narrowed from a width of 300 yards to 120 yards at the west end of the island, whereby the tidal wave has been reduced from a velocity of 18 miles to that of 8 miles an hour. The evidence of the late resident engineer, employed for six years by the trustees, is very important on this point, and deserves serious attention. Two lights also are much wanted in the river, one at the North Perch and the other above Bowling, where there is a great bend in the channel.

First Report, Ev. p. 23.

Between the western end of Newshot Isle and Erskine Ferry, the channel of the river is still encumbered with large whinstone boulders, which have caused great damage to deeply-laden vessels, by stripping off fragments of copper and lead from their bottoms, and, as it appears in evidence, causing some of them to go into dock at Greenock, or elsewhere, before they could proceed to sea. Yet when the resident engineer, conscious that this spot was the most dangerous to ships of the whole Clyde navigation, was using his utmost endeavours to have the stones removed, an individual of the Clyde trust, without any minute of the Committee or any other authority, presumed to send him a written order to discontinue the works and lay up the diving-bells in the finest part of the year.

Sufficient, perhaps, has been stated to show the imperfect state of the harbour and river, as respects accommodation for shipping and for navigation, and of its management, under the local trust; and to prove the necessity of some general supervision for the public interest, in order to protect the trade and shipping of Glasgow, the great western outlet of colonial and American produce.

App. C. Ev. p. 422.

With respect to the constitution of the Clyde trust, we have in evidence the distinct opinion of several of the trustees themselves, that it is far from being well adapted for its object; the members are thirty-three in number, which is admitted on all hands to be too numerous; they are principally composed of members of the Corporation, a yearly changing political body, whereby the business of the trust is much interfered with and impeded; there is no sailor, and

SCOTLAND.

App. C. Ev. p. 415.

only one ship-owner, on the Board, which has therefore no practical knowledge of the real wants of shipping, and this is the only way in which we can account for the great indifference shown towards the improvement of the river; whilst the cutting through of the Port-Glasgow and Garmoyle banks—the key to the navigation of the Clyde—appears to have been done entirely at the suggestion and through the perseverance of the late resident engineer.

App. No. 320. App. Ev. p. 415. App. Ev. p. 418. See plan, p. 518. App. No. 498.

It may be observed, with reference to these banks, that the depth of water on them decreased considerably during the period from 1768 to 1840. It appears from Golborne's Report in 1768, that "from Port Glasgow to the foot of Dumbuck Ford, there was not less than 12 feet at low water," whereas in 1840, the depth on Port Glasgow bank was only 5½ feet, according to one witness, and 4 feet by another; the depths also on Garmoyle Shoal and Dumbarton Bank had, it seems, decreased in a similar manner. Even after the dredging operations in 1842-5, just alluded to, we find from the Admiralty chart of the Clyde, completed by Captain Robinson, Lieutenant Bedford, and his assistants in 1846, that there are now but 9 feet over the Garmoyle Shoal at low-water spring tides, and only 6 feet at Dumbarton. If, then, Golborne's Report may be depended upon, there has been a general decrease of from 6 to 8 feet over these banks in the course of 70 years. That this shoaling has been the result of the deepening operations caused by the erection of dykes and jetties in the upper part of the Clyde there can be no doubt. From calculations, made with much care by the late resident engineer, Mr. Bald, it appears that during the above-named period, 1,725,000 cubic yards of fine sand and loose soil have been carried down from the harbour and upper part of the river. And the exclusion of the tidal water, owing to the dam or weir across the river, the mass of jetties and dykes, the shutting up of the South Newshot Channel, and the enormous encronchments thus made on the alveus (or bed of the river between high and low water), whereby it has been reduced to one-third its original width, has so diminished the tidal scour that it has caused the sand and soil washed down from above to deposit on the banks in the lower part of the Clyde, instead of carrying it fairly out to sea.

App. No. 323 App. No. 324.

The Clyde Trustees were early and repeatedly warned of the danger likely to arise from these sources. Rennie, in 1799, says: "The second material obstruction [to the scour] is the dyke or weir that has been built across the river just below the new bridge." Telford, in 1806, says: "It is of the utmost importance to attend to the channel of the river between the Long Dyke and Port Glasgow;" and, further on, he recommends the use of the "dredging-machine."* What a different river might the Clyde have been at this day had Telford's advice been followed!

App. No. 333. First Report, Ev. p. 23.

In 1824, Whidbey says: "The object appears to have been obtaining land from the river in preference to preserving the latter." Again, he says: "A canal is now being completed in the river, the width of which is contracted to about one-third of what it originally was;" and again: "It is needless for me to mention to you the number of rivers and harbours that have been destroyed by embanking, and making land on the side of them;" and again: "I am seriously of opinion that so much of the tide being prevented from flowing into its usual receptacles, will be the cause of banks and bars forming now far below Port Glasgow." And he concludes by saying: "I recommend the dredging-machine to be used in lowering these banks as they get up, that being the only means left for preserving the river for navigation." Yet, in spite of the repeated warnings of these eminent engineers, the Clyde Trustees made no proper effort to follow their advice, and when, twenty years later, the resident engineer attempted to dredge a deep channel through these shoals, and remove the boulder-stones, he was ordered to leave off, as above mentioned, before he had completed his work.

App. C. Ev. p. 407.

Another great evil in the constitution of the trust is, that a majority of the Clyde trustees are also Bridge trustees; and as the two trusts are separate, there is the double expense of management, without the check of an independent board, and thus, as has recently occurred, 20,000*l.* of the harbour funds, arising from dues on shipments and shipping, were voted away by a majority made up of Bridge trustees, to build a new bridge across the river for the accommodation of the citizens. The real interests of Glasgow require that the control of the bridges, as well as everything else connected with the river, should be vested in a properly constituted and responsible Clyde trust.

A strong illustration of the necessity for such a measure, and of the establishment of an independent Government Board of Control, is afforded by the recent attempts made by several railway companies to carry a viaduct across the Clyde. One company had the assurance to propose crossing the river below Glasgow Bridge; after a long Parliamentary struggle, attended with great expense, this bold project was at length defeated. Attempts were made for three successive sessions to cross the river below Stockwell-street Bridge, across the very space pointed out by the experienced harbour-master, and by all sailors connected with Glasgow, as that best adapted for harbour accommodation for the numerous and rapidly increasing class of small vessels trading to the Clyde, and these attempts were only put an end to by the veto of the Admiralty properly exercised.

App. C. Ev. p. 422.

It has been suggested by competent persons well acquainted with the port, that this is a suitable spot as a harbour for large vessels, as being close to the Custom House, in the immediate vicinity of the warehouses and of the business part of the city (instead of being at Stobcross, a mile down the river), and as capable of being adapted for such a purpose at less than one-third the expense at which docks could be formed at Stobcross. The space between the two bridges contains an area of 15 acres, or twice the extent of the King's Dock at Liverpool, and the quays on both banks belong chiefly to the corporation. Detailed estimates, showing

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* In October, 1805, seven months previous, Telford had recommended the use of the steam-dredging machine for deepening Aberdeen Harbour, to raise from 400 to 800 tons of soil a-day; this is the first mention of the application of steam to the dredging-machine, we believe, in Scotland, although it had been recommended by Grimshawe in 1796, and by Bentham in 1802. It was not used on the Clyde till 1824.

SCOTLAND.

App. No. 350.
App. No. 346.

the cost of executing such a measure will be found in the Appendix, and it will be seen that Captain Bethune, R.N., and Captain Denison, R.E., commissioned by the Admiralty to inquire into the state of the Clyde in May, 1846, were of opinion that this plan held out many advantages over the scheme for docks at Stobcross.

App. C. Ev. p. 422.

Such a plan would, of course, involve an opening in Glasgow Bridge, but even with this drawback it is worthy of mature consideration whether such a measure would not be preferable to burdening the harbour funds with the enormous debt which must be the result of carrying out the proposed docks or tidal basin at Stobcross.

App. C. No. 356.

For the present, however, we do not consider that it is necessary or expedient to make this space available for other than the coasting craft; it will be seen by a table in the Appendix that these small vessels, drawing six feet water and under, number 3154 in the year, or more than one-half of the arrivals of sailing vessels at Glasgow, and the removal of them above bridge would so materially relieve the pressure at the Broomielaw, that nothing more would be required for some time to come to afford ample accommodation for the shipping and trade of the Clyde.

App. C. Ev. p. 398.

We are, therefore, strongly and decidedly opposed to this part of the river being crossed by any railway viaduct, the construction of which would not only damage the space for the coasters, but prove a complete barrier to the carrying out of the above proposal should the trade of the port of Glasgow require it, and we are confirmed in this opinion by the evidence of many competent persons, including some of the Clyde trustees, who, from their position and experience, are well qualified to form an accurate judgment on the point in question.

The financial affairs of the Clyde trust, yet more than any other, perhaps, require the vigilant eye of an independent controlling power that could not be swayed by local interests; as we have seen above, the sum of a million and a quarter has been expended on works and management since the year 1770, and that the debt at the close of the year 1846 amounted to 383,800*l*., paying for interest 15,000*l*. a-year, or nearly one-quarter of the gross annual income.*

App. C. Ev. p. 400.
App. No. 495.
App. C. Ev. p. 392.
App. No. 354.
App. No 359.

Among the various items that have helped to swell this amount, the most glaring are the sums paid to purchase back the alveus of the river, which the Clyde trustees had allowed to be encroached upon;—the outlay of 7000*l*. a-year on dredging, a good part of which might have been avoided by removing well-known obstructions, encouraging the tidal flow to the utmost, and thereby increasing the scour;—the securing and rebuilding of the quay walls, some of which were erected only ten years ago, and are now falling into the river;—the purchase of the site of Windmillcroft, at an expense of 43,196*l*., and allowing it to lie idle for the last seven years;—the more recent purchase of a portion of the land at Stobcross at a cost of 63,750*l*., as a site for docks which probably will never be constructed;—and the expenditure of the enormous sum of nearly 57,000*l*. of the harbour funds during the last ten years in Parliamentary and legal expenses, in jury trials, and in hotel expenses of deputations of the trustees in London.

Parl. Pa. No. 556, 1846.

But the expenditure of the Clyde trust, supposing the works to be carried out that they have obtained powers to execute, and for which they have in part purchased land, would, it appears, involve them in a debt of a million of money, beyond the present amount of 383,800*l*. The interest of that large sum at only 4½ per cent., the lowest rate at which it is probable that money could be obtained, would be 62,000*l*. a-year, far above the whole present income from the trade and shipping. If to this be added the expense of management, and the ordinary expenditure on the river and quays, increased as it will be in proportion to the extent of wharfage, and which cannot be taken at less than 18,000*l*. a-year, it will be seen that at the end of ten years an income of more than 80,000*l*., at the very lowest estimate, will be required to enable the trustees to meet their liabilities, thus precluding the most distant prospect of lightening the dues on goods and shipping, and having the additional disadvantage of a railroad parallel to the river, with its terminus in the centre of the city, and extending to the deep-water harbours of Port Glasgow, Greenock, Troon, and Ardrossan, and actively competing for a share of the traffic.

We submit that this state of harbour affairs, under the local trust, proves that the management of the Clyde Trust has not been such as to afford the slightest pretence for exempting the Port of Glasgow from the general control that we have considered it our duty to recommend for the preservation of all the harbours of the United Kingdom.

RENFREW.

App. No. 362.

RENFREW.—The harbour of Renfrew communicates with the Clyde by a small canal, formed about the year 1785, partly in the old bed of a branch of the Clyde, which it is said ran formerly close to the town. A commodious quay was built here in 1835, at an expense of 800*l*. The harbour is held as part of the common property of the burgh, in virtue of royal charters, confirmed in 1703. The arrivals in 1846 were, 226 vessels of 11,478 tons, and the revenue of the harbour, 96*l*.

PAISLEY.

27 Geo. III. c. 56.
5 Will IV. c. 32.
App. No. 499.

In consequence of deepening the bed of the river Cart about the year 1787, and cutting a short canal to avoid the shoals at Inchinan bridge, at the junction of the Black with the White Cart, the river has been made navigable up to the town of Paisley, for vessels of 80 tons burthen. Additional improvements, for which an Act of Parliament was obtained, have been in progress since 1835, at an outlay of 22,000*l*.; a new quay was erected at Paisley, the canal widened, and the river deepened to 9 feet at spring tides. The arrivals in 1844 were 747 vessels of 23,676 tons, besides 55 rafts of timber. The revenue for the past year 400*l*., and the debt

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* The income for the year ending June 30, 1847, is 59,017*l*., and the debt 547,765*l*.

SCOTLAND.

47,645*l.* Heavy complaints are made that the navigation is much hurt; and, indeed, that the use of the new quay is nearly totally destroyed by accumulations of seeds poured into the river from flour-mills, situated above the town of Paisley, and out of the jurisdiction of the trustees.

PORT GLASGOW.

See plan, p. 518.

12 Geo. III. c. 16.

11 Geo. IV. c. 123.

App. No. 369.

App. No. 367.

PORT GLASGOW lies on the south shore of the Clyde, at 18¼ below Glasgow Bridge, and below all the shallows on the river, and has good anchorage off it in 18 feet at low water, and 28 feet at high-water spring tides. This place, as its name indicates, was originally intended as the seaport of Glasgow. The magistrates of that city, experiencing great inconvenience from the shallowness of the Clyde, felt the necessity of a harbour nearer the sea, and, in 1668, purchased about 22 acres of ground on the Bay of Newark, and constructed a harbour there, to which was given the name of Port Glasgow. From its advantageous position, trade rapidly increased, and in 1710 this port was constituted the chief custom house on the Clyde, and for some time it took the lead in the traffic of the river; in 1762, a graving-dock, the first in Scotland, was made here, under the direction of James Watt. In 1772, an Act was obtained for improving the harbour; and in 1801, a second Act, for amending the same. The harbour, as now enlarged, consisted of two tidal basins, of 3½ acres each, with an entrance 130 feet wide, facing the north-east. In 1828, a wet-dock was thought necessary, for which a plan was given by Mr Walker; and in 1830, an Act was obtained for carrying the work into effect. In 1833, however, it appears that a plan, by Mr. Atherton, C.E., was approved of by the trustees, and under his superintendence, a wet-dock of 10 acres in extent was begun, to the eastward of the tidal harbour; the entrance of the dock to be by a lock 53 feet wide, and having 14 feet depth on the sill at low water or 24 feet at high water. The outer wall of the dock had been only a few months in process of building, when, owing to the insufficient nature of the foundation, a part of it sunk under water, after which it was decided to complete it as a sloped rubble-stone embankment, instead of an upright wall. In 1837, it appears the embankment subsided farther, and in this state the works remain, after an expenditure of about 40,000*l.*, without any efforts being made to restore them; the lock-gates are out of repair, and cannot be closed (one of the bearing rollers having given away), the interior of the basin is not excavated, nor, owing to the state of the foundations, would it be safe to excavate it within a certain distance of the face of the walls.

App. No. 471.

The extent of wharfage here is 1570 yards; there are three building-yards, at which several of the mail steamers of 1800 tons burthen, have been built, employing about 150 shipwrights, and one graving-dock; there are also three harbour lights. The shipping belonging to the port, including steamers, are 67 vessels of 13,009 tons. The arrivals last year of sailing vessels were 980, of 74,604 tons, of which 71 vessels were from the colonics and foreign; and the custom dues amounted to 135,848*l.* The harbour revenue in 1846 was 2944*l.*, and the debt (entirely incurred in building the, at present, useless wet-dock) 36,500*l.*

11 Geo. IV. c. 123.

App. No. 485.

The harbour is under the management of not less than 61 trustees, of whom 50, composing the town council of Glasgow (a fluctuating political body), reside there, and have no connexion whatever with, or any interest in, the prosperity of the town or harbour of Port Glasgow. The secretary and treasurer, too, both reside in Glasgow, and fill similar offices in the Clyde Trust. Formerly, the trade of the place was almost entirely carried on in ships belonging to merchants resident in Glasgow; of late years, however, the merchants of Port Glasgow have themselves become shipowners, and, at present, one-fourth of the whole tonnage belonging to the place is owned by persons resident here. As, since the deepening of the Clyde and the establishment of steam-tugs, great part of the coasting and much of the foreign trade goes at once up to the Broomielaw, it is not to be expected that Glasgow merchants should take an interest in the welfare of a somewhat rival port, and the sooner they are relieved from having any share in its management the better for the harbour of Port Glasgow.

See plan, p. 518.

The works that are wanted here for the benefit of navigation generally are the removal of a portion of the east and north sides of the perch opposite the harbour, thereby enlarging the anchorage and navigable channel of the river; and for the improvement of the harbour, to build a graving-dock, fit to take in the large ships of 1000 tons and upwards, of Messrs. Pollok and Gilmour, which frequent the port, to complete the wet-dock by repairing the gates and walls, and to build a timber wharf on the outside, having two or three berths, with a depth of from 12 to 15 feet at low water. These two latter works might be executed probably for 6000*l.*, and for want of so small an outlay it is grievous to see a valuable basin rendered utterly useless.

GREENOCK.

24 Geo. II.

5 Vict. c. 54.

GREENOCK, as a port, occupies the most advantageous position in the west of Scotland. It lies sufficiently within the Clyde to reap all the benefit of its inland navigation and the security of a river, yet seaward enough to be free from all shallows, and to enable the deepest laden ship to arrive at, or depart from, its sheltered roadstead at all times of tide, and in all weathers, by night or by day. As early as the middle of the 17th century, Greenock was very largely engaged in the herring fishery, employing as many as 900 boats, and exporting the produce to foreign markets. The first harbour was erected by voluntary subscription, at a cost of 5600*l.*, between the years 1705-10; it enclosed an area of 13 acres, by curved piers, and was said to be at that time the greatest work of the kind in Scotland. In 1751, the first harbour Act was obtained, which named certain persons as trustees, and since that period eight other Acts of Parliament have been passed for regulating the affairs of the port, which are now under the management of 16 trustees, consisting of the magistrates and town council, with nine commissioners for Greenock and eight for Glasgow, elected by the shipowners—in all 33; but for twenty years no Glasgow commissioners have attended the meetings of the trust. Under these several Acts the harbour has been improved and enlarged; of the original piers, probably not a vestige remains, successive repairs and new erections having nearly effaced them. The chief of these was the enlargement of the old harbour and building of the new east harbour. For this work the trustees consulted Rennie, and acted upon his plan and report. App. No. 372. That eminent engineer directed special attention to placing the river walls exactly parallel to the set of the tide, and the result has been that the current has always maintained good depth of water, and steamers run alongside them at all times of tide. The works now consist of an east harbour of six acres, with an entrance 150 feet wide, and a depth of 10 feet at low water alongside the quays; and of a west harbour See plan, p. 518. of eight acres, entrance 100 feet; the extent of quayage is about 1800 yards, having the requisite sheds and cranes, one of the latter being capable of lifting 50 tons: there are four fine graving docks, three of which have 38½ feet width of entrance; and there is a harbour light on the central quay.

Rennie, in 1802, and Telford, in 1830, had, on the application of the trustees, given plans App. No. 373. and estimates for a wet-dock in the Bay of Quick, to the eastward of the harbour. Telford also planned a dock to the westward, but neither plan was carried out. The increasing trade of the port, however, requiring additional accommodation, the trustees, after maturely considering App. No. 375-6. the whole bearings of the question, decided that a tidal harbour would be more useful to the steam traffic and timber trade than a wet-dock, and Mr. Locke having furnished a plan, an Act 5 Vict. c. 54. of Parliament was obtained empowering the trustees to raise 220,000*l.*, in order to carry the plan into execution. The proposed eastern harbour, at an estimate of about 115,000*l.*, is in App. No. 377. progress; there is also a retaining wall now in the course of erection to the westward of the present harbours, to extend 50 yards beyond low-water mark, the expense of which will be 11,000*l.* The new harbour will have an area of 6½ acres, with a depth of 14 feet at low water, and 24 feet at high-water spring tides; the entrance to be 150 feet wide, and to be completed by the spring of 1848. A pier is also about to be erected by a railway company to the eastward of the harbours. Six of Mitchell's patent screw moorings are placed in the roadstead and found very serviceable. There is a patent slip, and nine building slips, besides those for iron steamers. Many of the largest and finest steamers in the United Kingdom were built at Greenock.

From the first foundation of its harbour in 1707, the trade of Greenock has rapidly increased; although, by the deepening of the Clyde and the introduction of towing by steam, some portion of both its coasting and foreign trade has naturally been transferred to the large manufacturing city of Glasgow, a very large amount of shipping still frequents Greenock, and, indeed, since the opening of the railroad there is a slight re-action in favour of the deep-water ports. The vessels belonging to the port are, 437 of 81,873 tons; the arrivals last year were, 2465 sailing-vessels of 204,984 tons; of which 261 vessels were from the colonies and foreign, and the custom App. No. 491. dues amounted to 324,477*l.* Besides the above, there were 13,311 arrivals of passenger steamers, and the revenue of the port was 13,686*l.* The debt is 115,472*l.*, with 38,687*l.* in hand, to make part of the outlay for the new harbour. When the present harbours were finished, in 1824, the revenue was 8900*l.*, and a table showing its progressive increase for the last 20 years, and the state of the debt for each year, will be found in the Appendix. Certain App. No. 379. anchorage and shore dues, averaging 1200*l.* a-year, although levied on shipping, are received by the corporation and laid out on the town. The expense of procuring the last Act of Parliament was 3972*l.*, a large proportion of which was incurred, it appears, "by the determined App. Ev. p. 502. opposition of Glasgow."

It has been proposed to construct a breakwater on Greenock Bank, which extends parallel to the face of the town, and shelters the roadstead from the eastward, and powers to do so were granted by the last Act, subject to the approval of the Admiralty. 5 Vict. c. 54. Such an erection might be beneficial, but it would require great judgment and care to place it exactly in the set of the stream of tide, and to make it just sufficient for the purpose intended and no more. The roadstead, although good, is already limited in space, as it appears, from the recent Admiralty Survey, that its width at the western end of the harbour is only 250 yards, opposite the steam-boat quay 200 yards, abreast the east harbour 150 yards, and just to the eastward of the new Admiralty Chart, 1846. works, only 100 yards, between the river wall and the 12 feet edge of the Greenock bank at low-water spring tides; whatever is to be done, therefore, must be done with the greatest circumspection, not only as regards this roadstead, but as it may affect Port Glasgow and the general interests of the river, a subject which has not by any means been sufficiently considered in the works that have been executed in the Clyde.

It appears from the memorial of the deep-sea pilots of Greenock, that their case is one of App. No. 378. great hardship; they are obliged to maintain expensive pilot vessels to enable them to go a considerable distance to sea, in order to look out for ships entering the Clyde; yet these ships, in many instances, refuse their services, while, on the other hand, the Glasgow river pilots trench on their rights by taking vessels out to sea beyond the limits of their licence. This is not right, pilots are a very valuable class of men, and it is for the interest of all parties that they should be supported in their calling; this can only be done by a proper system of management, and by making the payment of pilotage compulsory on all vessels above a certain tonnage, as it is at London, Liverpool, Hull, Glasgow, Ardrossan, and many other ports. Surely the trade of Greenock, which contributes to the Treasury 325,000*l.* a-year in custom dues, can afford the small and hard-earned pittance which falls to the lot of her deep-sea pilots.

The bay of GOUROCK, just within the mouth of the Clyde, is well sheltered, has deep water GOUROCK. and no shoals. As early as the year 1494, when Greenock was a mere fishing village, near two centuries before Port Glasgow was founded, the value of Gourock as a haven was acknowledged. By charter of 1694, the rights, shore dues, &c., were granted to the proprietor of Gourock; in 1835 an Act of Parliament was obtained, empowering a joint-stock company to 6 Will. IV. c. 79. erect and maintain a pier in this bay; the pier so constructed is a substantial work in stone,

See plan, p. 518.
App No. 382.

extending 100 yards off shore in an E. S. E. direction, with a return head of 50 yards to the south, and having a depth of 9 feet at low water, and 19 feet at high water at the pier head. The pier is much used by fishing-vessels, and for the export of paving stones, &c., and about 20 passage steam-boats touch at it twice each day in summer. Arrivals last year were, 412 sailing-vessels of 9619 tons, including 100 vessels seeking shelter; the revenue 403*l.*, and the debt 1933*l.* There are 18 fishing boats belonging to Gourock, and 32 boats between this bay and Largs, including the villages along the coast by Innerkip. At Cloch Point, two miles and a quarter west of Gourock, is a fixed white light at 76 feet above the sea, first placed in 1797 by the Clyde Light Trust.

LARGS.
2 Will. IV. c. 44.

LARGS harbour is formed by a small pier extending 90 yards off-shore, with a return head or kant of 47 yards to the north, having 5 feet depth at low water, and 15 feet at high water at the pier head. The pier was built in 1833, at a cost of 4275*l.*, by shareholders, incorporated by Act of Parliament. The arrivals last year were 187 sailing-vessels of 3071 tons, besides 1395 steamers, on their repeated voyages from all parts of the Clyde; the revenue 397*l.* There are 34 boats between Largs and Fairlie, employed in the herring fishery. It would be a benefit if the pier head were extended about 30 yards to the northward, and it ought to be marked by a coloured lamp by night.

MILLPORT.
App. No. 336.

MILLPORT, in the island of Cumbrae, has a steam-boat pier, extended in 1833 at an outlay of 750*l.*, raised by subscription; in 1841, it was much damaged by a storm, but has since been repaired, and has now 5 feet at low water, and 15 feet at high water at the pier head: to extend it into 10 feet depth at low water, which might be done at a small expense, would enable the Clyde steamers, which call here daily, to go alongside at all times of tide. The revenue in 1846 was 102*l.* On the western side of the Little Cumbrae is a fixed light, at 106 feet above the sea. The lighthouse was built in 1757, and rebuilt in 1793, and was one of the earliest erected in Scotland.

ARDROSSAN.
App. Nos. 390-2.
App. No. 394.
5 Vict. c. 62.
See plan, p. 614.

ARDROSSAN, at a projecting point, which forms the northern limit of the Bay of Ayr, is well sheltered by the Horse Island and outlying rocks from all but south-westerly gales. In 1805, Acts of Parliament were obtained for constructing a harbour at Ardrossan, and a canal from thence to Glasgow, according to plans by Telford. The projected canal was never formed farther than from Paisley to Johnston, and a railway from Glasgow to Ayr has now taken its place. The original harbour plan contained a wet-dock of 6½ acres, having 16 feet depth of water, this however was not executed, but in the course of the next two years a circular pier, 900 yards in length, was completed. In 1808 Jessop recommended the extension of the pier to the West Crinan Rock, a distance of 400 yards; but this was not done. During the next four years Rennie, Whidbey, Telford, and Stevenson were consulted relative to the harbour, but apparently their plans were too extensive, as they were not carried out. In 1839 Mr. Walker recommended finishing the wet-dock which had been begun, and constructing an entrance lock capable of receiving the largest steamer that navigates the Clyde. In 1841 a new Act of Parliament was obtained; these works have since been completed, and the harbour of Ardrossan now consists of two tidal basins, having 200 yards of quay wall in 21 feet depth of water, and 300 yards, varying from 10 to 20 feet depth, at high-water spring tides. Also of a wet-dock, or floating basin, of nearly 3¾ acres in area, having 500 yards of quay wall with 20 feet depth of water; there are the requisite sheds, cranes, and two red, leading, harbour lights, and, both with the steam-boat quays and the dock, there is direct communication by the Ardrossan Railway. For repairing vessels there will be a graving-dock in 14 feet water of sufficient dimensions, and a patent slip capable of taking up two vessels of 800 tons each; there are also several building-slips.

App. No. 389.
App. No. 431.

The greater part of these works were carried out at the expense of the Earl of Eglinton, the proprietor of the adjoining estates, and the cost is said to have exceeded 150,000*l.* Looking at the expenditure, and comparing it with the revenue arising from harbour dues, the outlay would appear imprudent, but considering the coal-fields that have been opened, the beds of black-band ironstone of great extent that have been discovered, the formation of the town of Ardrossan, and the general improvement of the estate, the construction of this harbour cannot be viewed otherwise than as a judicious measure; and the more so since the general disposition to carry railway traffic to the extreme deep-water ports has manifested itself. The harbour has recently become the property, by purchase, of the Glasgow, Kilmarnock, and Ardrossan Railway Company, but will remain in the hands of the present proprietor till the year 1850, at which period the works are to be completed. The arrivals and sailings last year consisted in 901 loaded vessels of 169,381 tons; of these, 46 vessels were to or from the colonies or foreign. The harbour revenue in 1845 was 1649*l.*

App. No. 396.

Since 1840, powerful and well-appointed steamers have been placed on the lines between Ardrossan and Fleetwood and Ardrossan and Belfast, and have afforded great accommodation to the public; by the latter line, the whole distance between Glasgow and Belfast has been accomplished in eight hours. Two plans for the extension of the harbour have been prepared by Mr. Moffat, resident engineer; one is to carry a pier from Eagle Crag 400 yards to the westward, then 800 yards northward towards the outer end of the Horse Island, leaving appropriate north and south entrances; and to connect the eastern side of the island with the main shore at Burnfoot, leaving a central opening. The other plan is to enclose the bay between Ardrossan and Saltcoats to the southward; the estimate for either being about 200,000*l.*

SALTCOATS.
See plan, p. 513.

SALTCOATS is a small district harbour, sheltered from the southward by a pier carried out to the inner Nebbock Rock, having a jetty projecting 50 yards to the northward, and leaving an entrance of 90 yards wide between it and the rocks on the north side. The quay affords a depth of 13 feet at high-water spring tides; there is a harbour light at the jetty end, and perches are placed to mark the outer Nebbock and north rocks. This harbour was first formed, in 1683, by Mr. Cunninghame of Auchenharvie, proprietor of the adjoining property, at his own expense, chiefly for the export of coal and salt; it is now governed by trustees under several Acts of Parliament, the most recent obtained in 1843. The arrivals and sailings last year were 215 vessels of 15,873 tons; the harbour revenue 166*l.*, and the debt 5370*l.* There are 18 fishing-vessels belonging to the place. A small sum of money expended in constructing a breakwater, and in deepening the harbour, would be of great benefit.

SCOTLAND.

App. No. 398.

6 & 7 Vict. c. 45.

IRVINE harbour is formed by the confluence of the rivers Irvine and Garnoch, which fall into the sea in a west direction, over a flat sandy beach, the outfall being guided in some degree by a rude pier or dyke on the south side 500 yards in length. In 1840 the channel was farther narrowed, and fixed by a series of half-tide rubble-stone jetties, run out on either side at an angle of 45° with the stream for the last 600 yards of its course, whereby it has been deepened from 2 to 3 feet, and the entrance limited to 240 feet in width. A shifting sandy bar extends without, having 13 feet over it at high-water spring tides. There are about 200 yards of stone quay, and a timber wharf of 70 yards was erected last year: there is a building-yard and patent slip for repairing ships. The number of vessels belonging to the port of Irvine are 120 of 16,237 tons. The arrivals and sailings in 1846 were 1139 vessels of 60,785 tons, of which 7 vessels were to or from the colonies or foreign; and the custom dues of the port were 3148*l.* The harbour revenue, arising from dues on shipping only, was 355*l.*, and the debt 1715*l.*

IRVINE.

App. No. 403.

See plan, p. 614.

Answers to queries.

6 Geo IV. c. 91.

Irvine has the advantage of the backwater derived from two rivers, which also, from the slight descent in their channels, offer an extensive reservoir for tidal water. Every effort should be made, therefore, to encourage the tide upwards, by removing projections, reducing the abrupt bends to easy curves, levelling the bed of the river, which is in hills and holes (in some places being 2 feet, and others close to it 12 feet deep), and by causing the two rivers to unite their waters at an acute angle pointing down the stream, instead of at a right angle as at present. A small outlay would effect these trifling improvements, and a great benefit might be expected as the result. A coloured tide light at the pier head is absolutely essential.

THE TROON is a remarkable rocky promontory, about a mile long by a quarter of a mile in width, projecting into the sea beyond the general line of the sandy coast. The extreme outer end curves to the northward, forming a bay, well sheltered from westerly gales; a part of this bay, by skilful engineering, and the expenditure of a quarter of a million of money, has been converted into the most capacious harbour on the Ayrshire coast.

THE TROON.

In 1808 an Act of Parliament was obtained by the proprietor (the Duke of Portland), authorizing the construction of a harbour and the levying of certain dues upon shipping making use of it, and shortly after the works were begun, under the direction of Jessop as principal engineer. In 1817 the north pier, 230 yards in length, was extended in a north-easterly direction, into a depth of 19 feet water; and an eastern wall or breakwater was built in a north direction to stop the sand-drift from Irvine Bay, and otherwise to shelter the harbour: this wall has recently been lengthened 230 yards, and its foundations laid in 11 feet at low water; it is 13 yards wide, and affords a convenient steam-boat quay, with sheds for merchandize, fresh water for shipping, and a branch line to the railway. The entrance between the pier heads is 300 feet in width, facing the north-east, with a depth of 19 feet at high-water spring tides.

48 Geo. III. c. 47.

The harbour now consists of an outer and inner tidal basin, each of about 15 acres; the outer one varies in depth at low water, from 11 feet at the entrance to 6 feet at the upper end: the inner basin is all but dry. A wet-dock of $1\frac{3}{4}$ acres, having 20 feet depth at low water, and an entrance 49 feet wide, opening into the harbour without gates, was completed last year. There are two graving-docks, the entrances respectively being 37 feet and 24 feet wide, three building-slips, employing about 100 men in ship-building, and 1500 yards of wharfage, with ample cranes. There is also a steam-dredge of 12-horse power, by means of which the outer basin has lately been deepened from 6 feet (to which it had been reduced) to 11 feet in depth at low water; and there is every appearance of intelligent and seaman-like superintendence throughout the harbour.

See plan, p. 614.

Answers to queries.

The piers are built of rubble-stone, faced with granite ashlar; the northern or breakwater pier is colossal in its dimensions as compared with any other harbour pier in Scotland; its *à pierre perdue* base is 47 yards wide at bottom, and has a slope of 3 to 1 to the surface of low water (where the pier is 30 yards wide), whence it rises 21 feet, nearly upright to the level of the quay at 10 feet above high water; above this again is a parapet wall 12 feet high, in all 48 feet from the base, and 33 above low water. The blocks of ashlar vary from 2 to 6 tons in weight; for additional strength, an outer course of stone, 7 feet thick, was placed at the back of the pier last summer, and brought up to the level of the quay.

See section, p. 712.

The arrivals and sailings in 1846 were 2436 vessels of 184,826 tons; of these, 85 vessels of 21,597 tons were to or from the British colonies and foreign, and the harbour income was 4003*l.* About 130,000 tons of coal were shipped last year at this port by means of the Kilmarnock and Troon Railway, now joined to the Ayrshire Railway, having branches to the basin and pier; 800 tons of coal, if required, can be supplied in one day. Since the commencement of the works at the Troon, great alterations have taken place. Owing to the accumulation of drift sand and deposit, the depth of water at the pier head was reduced from 18 feet to 6 feet, and the present depth was only gained by the free use of the steam-dredge. It is remarked, that along the whole of this sandy coast, the land has considerably gained on the sea within the last half century, nor is this more than might be expected, since as piers at the mouths of rivers are advanced into the sea, the adjacent sandy coast will always follow them. The harbour light at Troon was first shown in 1837; it is intermittent, and stands at 33 feet

App. No. 491.

App. No. 406.

SCOTLAND.

above the sea; but it is not placed at the pier head, nor within 300 yards of it. A light on the Lady Isle, just to the southward of Troon, would be a great boon to the mariner bound either to this port or to Irvine, and to navigation generally. A red light is now being placed on the pier head, and also a low bright light on the north breakwater, which will show the entrance into the harbour; and were there a light on the Lady Isle, the intermittent light above alluded to might be removed, as from its situation it must assuredly mislead a stranger.

AYR.

See plan, p. 614.

6 Will. IV. c.

AYR Harbour is formed by the mouth of the river which falls into the sea between piers having the entrance sheltered by a detached rubble-stone breakwater, with an opening 320 feet wide, facing north-west-by-west. A sandy bar extends without, having 15 feet over it at high-water spring tides. The banks of the river are quayed on each side from the bridge seaward, and afford about 1200 yards of wharfage, with three cranes, one of them capable of lifting 6 tons; 50 yards of the north quay were rebuilt in 1845; there are two iron-foundries for repairing steam-machinery; a building-yard, from which a vessel of 600 tons has been launched, employing about 70 shipwrights; a patent slip proved for 400 tons; and a steam-dredge of 8-horse power, by means of which the river has been deepened nearly 3 feet, and the bar much improved. The harbour is managed by 24 trustees, 13 of whom are members of the town council, under four Acts of Parliament, from 1772 to 1835; the last gives power to raise 10,000*l.* The harbour lights are very good; they consist of two fixed bright lights, 280 yards apart, to lead into the channel, and a red tidal light shown when there are 8 feet water on the bar.

App. No. 410.

App. No. 411.

App. No. 413.

App. Ev. p 542.

The engineering history of Ayr Harbour is curious and instructive. As early as 1771, James Watt was consulted on its improvement, and gave a plan for extending the piers in a straight and parallel direction to the same distance to seaward; in 1772, Smeaton advised that the north pier should be slightly curved, and extended 30 yards beyond the south pier head, and that both be raised above the level of high water; in 1805, Rennie recommended the same plan as Smeaton, only to carry the piers rather farther out to sea, and, in addition, proposed a wet-dock of 5 acres area in the ground called Newton Loch, entering at the east end of the north dyke; none of these plans appear to have been executed with the exception of a partial extension of the north pier in 1800, and the rebuilding and extension of the south pier in 1825, still leaving it to project 100 yards beyond the north pier, notwithstanding the concurrent advice to the contrary of the three above-named eminent engineers. In 1830, Mr. R. Stevenson was consulted, who having made a careful survey of the harbour and its approaches, again recommended the extension of the north pier beyond the south pier, giving it a slight kant to the southward, nearly as Smeaton had suggested in 1772; also, that the rocks inside the harbour just below the bridge should be removed, and the bed of the river levelled; he further stated that he could not advise a detached breakwater at the entrance of the harbour. In 1836, the trustees, acting on a plan by Mr. Gibb, C.E., erected a detached rubble-stone breakwater, 133 yards in length, at 100 yards distance from the north pier head, and lying partly across the entrance. It is still incomplete, only raised to the level of ordinary high water, and gales of winds wash the stones down on the outside. In 1846, Mr. Leslie gave a plan for a tidal basin of three acres, capable of extension, on the south side of the harbour, but the trustees failed this session in obtaining an Act to carry the work into execution.

App. No. 451.

The arrivals and sailings last year were, 2366 vessels of 135,393 tons; of these 28 vessels of 5915 tons were to or from the colonies and foreign, and the vessels belonging to the port were 41 of 4401 tons; the revenue 1825*l.*, and the debt 1929*l.* The chief exports are coal and freestone, and owing to the extension of inland communication by railroad, as well as a steamer to Campbelltown and Stranraer, a large increase of traffic is expected, for which, in the present state of the harbour, there is no room.

App. Ev. p. 543.

App. No. 417.

It appears in evidence, that there is great want of quay accommodation; that vessels lie exposed to the freshes, which come down at times in great force, and leave the bed of the river in a very uneven state. They are also exposed to the heavy swell that ranges along the piers in south-westerly gales, and, consequently, there is a strong necessity for a tidal basin. That the breakwater requires to be built up above high water, and to be completed; that there are many boulder-stones and rocks in the harbour that should be removed; that the quays and piers are very much out of repair; that sand and rubbish are thrown into the river above bridge, and that the trustees have no power to prevent it; that a mill-dam dyke across the river stops the upward flow of the tide; that coal, the staple trade of the port, pays no dues; and that a portion of the dues levied on goods and shipping is applied to municipal purposes, and not expended on the harbour.

GIRVAN.

App. No. 419.

GIRVAN, a small harbour at the outlet of the Girvan Water, has been improved within these few years, and now affords shelter to vessels not exceeding 10 feet draft of water. The arrivals and sailings last year were 437 vessels, of 17,457 tons, including a steamer which calls here weekly; and the revenue from anchorage dues levied by charter was 63*l.* This is a large fishing station, having 34 boats, and employing 90 men. Colzean, a few miles to the north, has 12 boats. Dunure Creek, a small secure basin, entered by a channel 50 yards wide, cut through the rock about the year 1811, has 20 fishing-boats belonging to it.

BALLANTRAE.

At BALLANTRAE a fishing harbour is now in the course of construction, and will shortly be completed from a design by Mr. Mitchell, C.E., at a cost of 5397*l.*, one-half of which is to be paid by the Fishery Board, on the part of the public. Its area will be about one acre, sheltered by a breakwater pier 70 yards in length by 6 yards in width. It is built of rubble-stone faced with ashlar masonry, the outer courses of stone are set on a slant and dowelled together. The quay will be 6 feet, and the top of the parapet wall 13 feet above high water. It is proposed to excavate the rock from the berths alongside the quay to a depth of 3 feet at low-

SCOTLAND. water spring tides. A harbour here is much wanted, and there cannot be a doubt but that it will prove a great benefit not only to the fisheries but to the surrounding districts.

LOCH RYAN. LOCH RYAN, a deep inlet, 10 miles in extent, accessible at all times, and one in which vessels may ride in security with all winds, is well known to the mariner frequenting this part of the coast of Scotland as a capacious natural harbour of refuge, as many as 360 vessels having sought shelter there during one winter. It has hitherto, however, been rendered comparatively useless by night, from want of a small harbour light on the Cairn Point, in the immediate vicinity of the best anchorage in the loch, as well as a conspicuous beacon to mark the Scar Spit.* It appears, from documents printed in the Appendix, that, since the year 1820, App. No. 423. when steamers first proved the possibility of crossing the channel in all weathers, Loch Ryan has been considered, by many persons well qualified to offer an opinion, as the natural and best station for the packets keeping up mail communication with Ireland; and Larne, a similar natural deep-water harbour, the best station on the opposite coast.

STRANRAER. STRANRAER, at the head of the loch, has a pier extending 200 yards off-shore, in a north-north-east direction, with a return head to the eastward. It has 11 feet depth at high-water spring tides at the pier head, where a bright light is exhibited. It was built in 1820, at a cost of 4500*l.* There is excellent and secure anchorage in the roadstead off the town. The coasting traffic by steam has recently much increased. The arrivals and sailings last year were 462 loaded vessels of 36,780 tons, besides steamers to Glasgow, Belfast, and Whitehaven. The vessels belonging to the port are 36, of 1800 tons. The revenue levied by custom was 188*l.*, and the debt incurred in building the pier 3424*l.* It has lately been proposed to project a pier 230 yards beyond the present into a depth of 10 feet at low water. The pier to be of timber with a stone pier head. Estimated cost, 5500*l.*

PORTPATRICK. PORTPATRICK COVE, which has no claim to be called a harbour, affords an area of half an acre, so far sheltered as by means of frigates' cables two small mail steamers can generally be held at their moorings. The entrance is open to the heaviest and most prevalent gales, and in consequence of this exposure, and of the position of the old pier which lies in the very worst possible direction, the run of the sea which sweeps round even the inner cove is fearful.

See plan, p. 614. From want of water over the bar, there being only 3½ feet at low-water springs, the present small steamers are obliged to haul out of the inner cove and lie in the entrance some hours before the time of sailing. So exposed is this situation, that more than once the packet has been compelled to go to sea without mails or passengers, the heavy swell tumbling in preventing the vessel from remaining or communicating with the shore. The same want of water over the bar either obliges the steamers to lie to outside or detains them in Donaghadee until the tide has risen sufficiently to allow them to enter without danger.

App. Ev. p. 560. The width of the unfinished entrance is 90 yards (intended to be 60 yards). The north pier, being left incomplete, forms an artificial reef of rocks covered at half-tide; the remains of the coffer-dam form a similar danger for the whole length of the pier on the south side. The lighthouse at the end of the pier remains unlighted, as in stormy weather no one can venture out along the pier to light it. In gales of wind, the sea rolls up the tower, and the spray flies twenty feet above the lantern.

In leaving Portpatrick in blowing weather, so confined is the space that the officer in charge of the station is obliged to watch from an eminence the heavy seas tumbling in, and when he perceives symptoms of a lull, gives the word to "go on:" if two heavy seas in succession were to strike the packet on either bow before she were to get good headway, she must inevitably go upon the rocks. That no accident has hitherto happened to the two inefficient steamers that carry on the packet service from hence to Donaghadee can only be attributed to the skill and nerve of the commanders, mates, and pilots of the vessels. The risk to which they are exposed is perhaps greater than on any other service under Her Majesty's Government.

The Commissioners complain, with some justice, that while they are considered responsible for the silted up and insecure state of the harbour, their representations of the necessity of immediate dredging, and of bringing the works to a conclusion, are not attended to. If the place is to be maintained, it would seem desirable at once to relieve the Commissioners from any further responsibility, to place the harbour under the Admiralty, and give the whole charge to the naval officer having the superintendence of the packets, who, with a single clerk, could easily do all the work that is required; but more especially, and, without a day's loss of time, to set a dredging-machine to work to deepen the harbour to at least 7 feet at low water.

App. Ev. p. 561. From Parliamentary Returns, it appears that the cost of the works at Portpatrick has been 170,000*l.* The gale of January, 1839, caused damage to the amount of 13,800*l.* The estimate to complete the works is 35,000*l.* The cost of establishment and maintenance is about 4,000*l.* a-year. Of all the harbours in Great Britain, Portpatrick offers the *minimum* amount of shelter for the large amount of money that has been laid out upon it.

The only argument worthy of consideration hitherto urged in favour of the passage by Portpatrick and Donaghadee, is the shortness of the sea-voyage; as an abstract principle, this is undoubtedly right, and had double force while sailing-vessels carried the mails; but if applied practically as an argument for retaining these harbours at the present time (Nov. 1846), the following statement will serve to test its value:—

Letters from London to Belfast by Portpatrick, by H.M. Mails, are carried in	40	hours.
Newspapers from London to Belfast by Fleetwood, by private steamers, in .	20	,,
Letters from Glasgow to Belfast by Portpatrick, by H.M. Mails, are carried in .	20	,,
Newspapers from Glasgow to Belfast direct, or by Ardrossan, by private steamers 1 in	0	,,

It thus appears that the Treasury, the Post-office, and the Public would be gainers by giving up Portpatrick as a packet station.

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* The Cairn Point has since been lighted, and the beacon on the Scar Spit is to be placed.

SCOTLAND.

PORT LOGAN.
58 Geo. III. c. 61.
App. No. 432.
Lighthouse Report, 1846.

PORT LOGAN, at the head of Port Nessock Bay, has a pier extending 180 yards off-shore in an easterly direction, built by the proprietors of the adjoining estate, under an Act of Parliament obtained in 1818. It has a depth of 12 feet at high-water spring tides. Revenue, 10*l*. Port Nessock Bay has long been spoken of as a favourable site for a packet station, and as a harbour of refuge. Telford and M'Kerlie, who examined the whole of this coast in 1809, by order of Government, with a view to select a packet station, reported in favour of Port Nessock. Had the same money been laid out in constructing a breakwater in this capacious bay that has been expended on the rocky inlet of Portpatrick, the mail communication with Ireland could have been equally well kept up, and the 2,000,000 tons of shipping from Liverpool and the Clyde that annually pass by here would have had the advantage of an asylum harbour under their lee if caught in a gale on this iron-bound coast.

MULL OF GALLOWAY.
Lighthouse Report, 1846.

The prominent rocky peninsula known by the name of the **RHINNS OF GALLOWAY**, which forms the eastern shore of the Irish Channel, here narrowed to a width of 18 miles, has a light at each extremity. At Corsewall Point, to the north, is a revolving light, showing alternately white and red, at 112 feet above the sea: it was placed in 1817. At the Mull of Galloway, to the south, is an intermittent light, at an elevation of 325 feet, first placed in 1830. Since it was lighted it has proved a great safeguard for vessels, which commonly ran ashore in the great opening of Luce Bay, on the eastern side of the peninsula, mistaking it for the north channel. From official returns, the number of loaded vessels that paid dues for passing this light in 1846 was 15,342, of 2,179,971 tons.

DRUMORE.
App. No. 421.

The harbour of **DRUMORE**, upon the west side of the Bay of Luce, about four miles from the Mull of Galloway, has a small pier, built by the proprietor of the adjoining estates (the Earl of Stair), for the accommodation of the coasters which supply the district. The small Bay of Drumore is of easy access, and affords fair anchorage for wind-bound vessels and for those stopping tide. The dues average about 50*l*. a-year. The arrivals and sailings last year were, 148 loaded vessels of 5687 tons.

PORT WILLIAM.
See plan, p. 518.
App. No. 448.

PORT WILLIAM, on the east side of Luce Bay, has a jetty or pier, 120 yards long, on the south side of the harbour, leaving an entrance between it and the north battery 100 feet in width. This harbour has the great advantage of a 17 feet rise on spring tides. The jetty head does not reach within 100 yards of low water, but it has been proposed to extend it so far. The works were built by subscription, and the dues fixed and levied by mutual consent. There is a considerable district trade. The arrivals and sailings last year were 205 vessels of 7521 tons, and the revenue 157*l*.

WHITHORN.
App. No. 449.

The isle of **WHITHORN**, two miles north of the promontory of Burrow Head, shelters a small bay having a pier, erected about the year 1790 by the aid of the Convention of Royal Burghs, which affords accommodation for the small coasters that supply the district. The dues are levied under a charter of King James IV. of Scotland, ratified in 1662, and produced 95*l*. last year. The arrivals and sailings in 1846 were 173 loaded vessels, of 4890 tons.

GARLIESTOWN.
App. No. 452.

The bay of **GARLIESTOWN** is sheltered from the north-east by the rocky point of Eagerness; it has a pier extending 100 yards in a north-east direction, with a depth of 17 feet at the pier head at high-water spring tides. The pier is partly protected on the south by an unfinished breakwater 140 yards long. The quays and pier were built by subscription at a cost of 2600*l*., and the latter completed in 1838. The arrivals and sailings last year were 242 vessels of 15,436 tons, of these 3 vessels of 900 tons were to or from the colonies or foreign; the revenue from dues paid by mutual consent was 133*l*., and the debt incurred in building the breakwater pier 545*l*. The end of the breakwater is still 200 yards short of low-water mark, and it would be a great benefit to the trade to extend it at least a portion of that distance, and thus enable vessels to go alongside it earlier in the tide.

WIGTOWN.
App. No. 456.

At **WIGTOWN**, a creek, formerly used as a harbour, having become inaccessible in 1818, in consequence of a change in the course of the river Bladenoch, a new harbour was soon after erected, at the expense of the burgh, well adapted to the coasters that ship the agricultural produce of the neighbourhood. The arrivals and sailings last year were 296 vessels of 20,412 tons, and there are 69 vessels of 3730 tons belonging to the port, including one steamer which plies between Garlieston, Kirkcudbright, and Liverpool. The revenue arising from dues levied under authority of the magistrates and council were 109*l*. in 1846. At the outlet of the river Cree, which flows into the head of Wigtown Bay, is the small harbour and roadstead of **CREETOWN**, at which 293 coasters of 20,270 tons arrived during the last year.

App. No. 458.

GATEHOUSE, at the head of Fleet Bay, is stated to be a private harbour, the dues, amounting to 40*l*. per annum, are levied with the consent of the authorities of the burgh. The arrivals and sailings in 1846 were 158 loaded vessels of 4680 tons. At Baldoon and Carty, quays on the property of the Earl of Galloway, the dues amounted, in 1846, to 15*l*. and 17*l*. a-year; and the arrivals were 63 and 70 vessels, respectively.

KIRKCUDBRIGHT.

KIRKCUDBRIGHT Harbour is in the channel of the Dee, a short distance above where the river opens out into an estuary, and at four miles from its junction with the Solway Firth. The northern or river face of the town is quayed, and has a depth of 17 feet at high-water spring tides; in the channel of the stream abreast the town there are 7 feet at low water and 30 feet at high water, and the tide flows to Tongueland, two miles above the town, where it is stopped by a rocky barrier. The harbour is governed by the magistrates of the burgh, and the dues are levied under a charter of James II. of Scotland [1453], confirmed by Act of Charles I. [1633] The arrivals and sailings last year were 426 vessels of 31,285 tons, including 5 vessels to and from the colonies or foreign, but exclusive of the weekly trips of a steamer to Whithorn and Liverpool. The revenue, arising from dues on shipping alone, was 93*l*.

See plan, p. 614. App. No. 461.

The west side of Kirkcudbright Bay is sheltered by the island of Little Ross, forming a good roadstead within it, having 16 feet at low water; in westerly and south-westerly gales this is the best, and indeed the only refuge along the coast from Liverpool to Loch Ryan, and since the light was placed on Ross island it has been much frequented by shipping. At about 1½ miles above the island is a bar, having only 3 feet over it at low-water spring tides, and 9 feet at low-water neaps, but with the great advantage of a 23-feet rise of tide. The Dee is navigable at tide time to Tongueland, at about 6 miles from the Solway, and with the aid of a short canal to enable vessels to surmount the rapid rise in its bed which occurs at that place, it might be the medium of inland navigation to the centre of Kirkcudbrightshire.

Admiralty Chart.

WATER OF URR.

GIBB'S HOLE, at about a mile and a half from the entrance of the water of Urr, affords a depth of 9 feet, after crossing a bar of only 3 feet, at low water; it is fully protected by nature from all winds, and is a convenient stopping place for vessels bound to Barlochan and Dalbeattie. At BARLOCHAN or Palnachie, three miles higher up the river on the west shore, is a creek having one side faced with timber for about 100 yards, with a depth of 20 feet at high-water spring tides. Here is a traffic of 373 vessels of 12,628 tons, but there are no dues levied, nor is there any harbour master; and, in consequence, there are many disturbances about berths for loading and discharging. At DALBEATTIE port, three miles higher up the stream, there is a stone quay 116 yards in length, with a depth of 10 feet at high-water springs. About 170 vessels load and discharge here in the year. Were there funds to pay for it, this river might be much improved at a moderate expense, and become a good tidal harbour. BALCARY Bay, at the entrance of the large inlets of Auchencairn and Hestan bays, which dry entirely at low water, offers shelter to small coasters that do not fear to take the ground. A small harbour light at Hestan would be a great boon.

App. No. 454.

DUMFRIES.

The harbour of DUMFRIES is formed by the river Nith, and may be considered to extend 4½ miles below the town to Glenhowan Point, where the estuary or firth begins, which reaches 9 miles farther to Southerness. Within these limits there are nine landing places, as Southerness, Carse-thorn, and New Abbey Pow on the west or Kirkcudbright shore of the estuary; Glencaple Quay, Kelton Scar, and Laghall, Kingholm, Castledyke, and Dumfries quays on the left or east bank of the river. Previous to 1810 the navigation of the Nith had become very dangerous even for small vessels, and quite impassable above Kelton for vessels above 60 tons burthen, except in high-spring tides; and in consequence, the merchants and shipowners of Dumfries resolved to apply to Parliament for power to levy dues, &c. A report on the state of the river and a plan for its improvement, on a very limited scale, was made by Hollinsworth, and in 1811 an Act was obtained appointing Commissioners, giving authority to levy dues, and to raise 16,000*l*. In the following years a partial straightening and deepening of the channel took place, under the superintendence of Mr. Newall as resident engineer; during the periods from 1811 to 1814, and from 1836 to 1840, a portion of a new channel, having 6 feet at low water, was formed through Netherwood Merse and Kingholm Merse; and the river between Kingholm Quay and Castledyke was much improved by the removal of rocks; but, either from want of funds or some other cause, the works have not been carried on with vigour; no systematic plan has been steadily acted upon, and it appears the proprietors of the adjoining lands had been permitted to project dykes or jetties into the channel, some of which it has been necessary to remove.

See plan, p. 614. App. No. 464. 51 Geo. III. c. 147. App. No. 465.

There are now 1014 yards of wharfage at the several quays, but 230 yards of this amount at Dumfries, built in 1824, are unavailable for vessels; there is also a small tidal basin at Kingholm. The rise of tide at Southerness in the Solway is 26 feet; at Glencaple Quay there is a depth of 15 feet at high-water springs, at the New Quay 10 feet, and 6 feet only at Dumfries, where the river is crossed by a mill-dam weir, above which the tide does not rise. A good fixed light is maintained by the port at Southerness. The arrivals in 1846, within the river limits, were 755 vessels of 49,319 tons, and at Carse-thorn pier, including sailings, 184 loaded vessels of 11,076 tons; of these 14 vessels were to or from the colonies or foreign, and the custom dues for the whole port amounted to 11,075*l*. The channel of the Nith might be much improved, but it can only be done by a plan carefully considered and steadily followed out, and the commanding rise of tide in the Solway, the approach of railways, and the increasing trade of Dumfries, give every encouragement to undertake it.

App. No. 491.

ANNAN.

ANNAN harbour is formed by the outlet of the river which falls into the Solway Firth, at a mile-and-a-half below the town. A small portion of its south-eastern bank is quayed, and there are two open-piled jetties, belonging to a steam-packet company, at Annan Waterfoot, otherwise the river is in a state of nature. The tide rises 20 feet on springs at the entrance of the river, and makes itself felt at two miles above Annan bridge. At half-flood, on all tides, vessels drawing 12 feet water can go up to the jetty at Waterfoot. A mill-dam dyke crosses the river at about 100 yards below the bridge, and a viaduct for the Carlisle and Dumfries Railroad will cross it at about 100 yards lower down the stream. The vessels belonging to the port are, 31 sailing vessels of 2345 tons. The arrivals in 1846 were, 698 vessels of 67,298 tons, five of which vessels were to or from the colonies or foreign. The only dues

See plan, p. 614. App. No. 470

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SCOTLAND. levied are 3*l.* a-year. At Barnhill Point, or Annan Foot, is a tide light, shown at half-flood. Some buoys might be placed with advantage at the entrance to the river. A steamer plies constantly to Liverpool, for which place large quantities of sheep and cattle are shipped. The river is capable of improvement at a moderate outlay, and, were slight dues imposed on goods, a fund for such a purpose might readily be raised.

SOLWAY FIRTH. There are two channels leading up the SOLWAY FIRTH, on either side of the Three-Fathoms and Middle Banks. The southern, or English Channel, is now well lighted and buoyed, and, with the assistance of the very complete Admiralty charts of this region of rapid tides and extensive sandbanks, is comparatively safe. But the navigation of the Scottish shore would be much improved by a small harbour light on Hestan Island, thereby affording a guide to the numerous coasters that run for shelter into Balcary Bay at tide time, as well as into the Water of Urr, both of which places offer good shelter when vessels are obliged to bear up against the prevalent south-west wind. A good bell-buoy on the spit of the Two-feet Bank, off the south-west end of the Dumroof Bank, about half way across the Firth, between Kirkcudbright and Workington, to warn the mariner in hazy weather of his approach to a dangerous shoal, might also be very useful. App. No. 486.

For further details respecting the harbours of Scotland, reference may be made to the Appendix, for the evidence taken at each of the principal places, and to the various engineers', and other reports, including tables of income and expenditure, and of arrivals and sailings, as well as to the small plans of the harbours, and the sections of the chief break-water piers. This mass of information on the Scottish ports is, probably, much greater than was ever before collected, although it is still far from being complete, not from any unwillingness on the part of the trustees to communicate their documents, but owing to the general indifference with which harbour affairs have hitherto been treated; in some cases, neither plans nor reports could be found, and the returns made to Parliament were consequently imperfect.

We have much gratification in acknowledging the assistance we received in the course of our examination from the Admiralty surveyors, Captain Robinson and Lieut. Bedford, on the west coast, and Captain Otter, R.N., on the east and north coasts, and from the Admiralty charts, plans, and sailing directions, prepared under their superintendence; also from the Officers of the Coast-guard, the Collectors of Customs, and Lloyd's Agents around the coasts of Scotland. We have likewise to acknowledge the information derived from the Reports of the British Fishery Board, and of the Board of Northern Lights, and from the Messrs. Stevensons, Bald, Leslie, Abernethy, Mitchell, May, Bremners, Ower, and Moffat, civil engineers, who have readily and gratuitously furnished the Commission with plans, drawings, sections, and all kinds of information whenever they were requested.

SHIPWRECKS. Among other general points which have come before us in the course of our inquiries, there is one too intimately connected with the state of our harbours and coasts to be passed over without notice, I mean the frequency of shipwreck around the shores of the United Kingdom. The Appendix to this Report contains long lists of wrecks off Dunbar, Peterhead, and elsewhere, along the east coast of Scotland, and a reference to Lloyd's list will show a loss of about 600 British ships every year, and including foreigners trading to this country, vessels not registered at Lloyd's, and wrecks unrecorded, we shall not err greatly in assuming the loss at two vessels a-day throughout the year, with life and property to a great extent. Many causes, probably, combine to produce these casualties, as stress of weather and want of good harbours, rapid tides, shoals, want of lights, buoys, and beacons (although this last cause is much diminished of late), bad charts, unseaworthiness of vessels, being ill-found with anchors and cables, incompetency and neglect of masters, and drunkenness. The recent regulation by which masters may be examined will do some good, but as the examination is not compulsory, much cannot be expected from it. As the case stands at present, it is difficult to say to which of these several causes wrecks are to be chiefly attributed, and we are thus, in some measure, liable to legislate in the dark. I would submit, then, that a public Court of Inquiry be held on the spot in every case of wreck along the coasts of the United Kingdom, whether attended with loss of life or not: it could be as easily managed as an inquest, the machinery for the purpose being already organised; the Inspecting Commander of the coast-guard of the district, the Collector, or chief Officer of Customs, and Lloyd's Agents, are to be found everywhere, and they would form a tribunal, well acquainted with nautical affairs, in which all merchants and shipowners would have confidence; and were such a body, with the assistance of the nearest magistrate, authorised to inquire into and report on every case, there is little doubt but that in a very few years the list of wrecks on our own coasts would be diminished one-half.

BALLAST. Another point to which it is again necessary to revert, is the throwing over of ballast in our harbours, and rivers, and roadsteads. It will have been seen in the course of this Report that there are many complaints of this practice, at Kirkwall, at Stromness, at Lochindaal, and even in the Firth of Forth. Nor is the pernicious custom confined to Scotland only, the inquiries of this Commission have proved that ballast is commonly thrown overboard in, or on the passage to, all coal ports, as Shields, Sunderland, Hartlepool, and Stockton; in all mining ports, as at Swansea, Neath, Milford Haven, Fowey, and Falmouth; in all ports where stone is shipped, as at Whitby, Portland, &c.; where cement stone is dredged up, as at Harwich and off Sheppey; and at Larne, Skerries, Bantry, and elsewhere in Ireland. The Act of Parliament is distinct, and imposes a penalty of 10*l.* for each offence, but apparently it is no person's business to enforce it, and the injury is daily continued. I would, therefore, suggest:—1st. That 45 Geo. III. c. 159. s. 11.

SCOTLAND.

the section of the above-recited Act relative to the throwing out of ballast be printed separately, and circulated to every harbour and creek in the United Kingdom, with notice that it was the intention of the Admiralty in every case to enforce it, and that half the penalty would be given to the informer. 2d. That the collectors and sub-collectors of customs, the officers of coast-guard, and all surveying officers, be directed to give information to the Admiralty in the event of any case occurring; and that the Admiralty solicitor be instructed to prosecute immediately on the part of the Crown, to press for a conviction, and for full penalties; and, lastly, in order to put a more effectual stop to this reckless practice (which is ruining our harbours and roadsteads), that the custom-house clearance be refused to a ship-master until he had given proof of the quantity of ballast shipped in his vessel, and that he had discharged the whole of it either in a greater depth than 10 fathoms of water off the coast (not being near a roadstead), or deposited it at a ballast quay, or some other lawful place; and this quay or place all harbour trustees should be bound to provide. The two first regulations are quite within the power of the present Act. The last may require a section to be introduced in some future Act of Parliament.

LIGHTHOUSES.

With reference to another important subject connected with harbours, we are compelled to remark that the coasts of Scotland are not sufficiently lighted; and, at the time of our visit, were very far from being sufficiently buoyed. In order to light the mainland, Orkney, Shetland, the Hebrides, and outlying rocks and islands (an extent, measured roughly, of about 1200 miles), there are only 26 separate coast lights maintained by the Commissioners of Northern Lights. It will have been seen, in the course of this Report, that on the coast of Caithness, and on the west coast of Sutherland, Ross, and Inverness, there are distances of 60, 70, and 80 miles without a light. That the Sounds of Mull, Skye, Islay, and Loch Eil (the south western approach to the Caledonian Canal) are entirely without lights. Also, that the natural harbours of refuge, Stromness, Campbeltown, and Loch Ryan are in a similar manner almost unavailable by night. It is fully admitted that the lights that are placed are brilliant and effective (when not too high), and that the able and zealous engineer to the Board has spared no pains to obtain the best description of lenses and reflectors; but our complaint is, that the lights are too few for the safety of navigation, and especially on the west coast of Scotland, where the mariner has often to contend with rapid tides and stormy seas during a long winter's night, with the knowledge that he has good natural harbours under his lee which he dare not run to from want of a light.

The state of the buoyage at the time of our visit, in September and October, 1846, was even more defective, and with less excuse, as buoys and beacons can be placed at a trifling expense. The approach to Inverness and the Caledonian Canal at that period had neither buoy nor beacon to mark the channel between seven dangerous shoals on either hand; these, we understand, have since been placed; but Loch Eil, the south-western approach to the canal (which is now open for traffic), is to this day equally without lights, buoys, or beacons, and requires, probably, a similar number to fit it for the trade that is expected to take advantage of the Caledonian Canal.

The light dues on coasting vessels in Scotland have been lowered 50 per cent. during the past year; but the sum of 47,895*l.*, which was the gross income of the Board of Northern Lights during the year 1846, would surely entitle the mariner to demand the expenditure of a few hundred pounds, in order to place the necessary buoys and beacons around the coasts of Scotland.

PILOTAGE.

Another point connected with the safety of our shipping is the present state of pilotage. It may be seen in the evidence, and by documents printed in the Appendix to this Report, that in many cases pilots pass no examination, but are licensed by a committee composed of a provost and baillies on receiving certificates of good character. Also that, owing to the payment of pilotage not being compulsory in some of the larger ports, as at Dundee, Greenock, &c., efficient men cannot be obtained to serve as pilots; or if obtained, they serve at a loss; that in the Tay, no proper pilot-boats are kept up fit to cruize outside the sands, and thus it not unfrequently happens that vessels cannot obtain pilots in bad weather when they are most needed, and not unfrequently wrecks occur. In the Pentland Firth, it appears that the pilots are commonly paid in part from the stores or cargo of the ship (which in itself is an infraction of the revenue laws, and a fraud upon the owner); they are also occasionally not landed but taken away to Iceland, and sometimes to America. I would submit then that all pilots should be compelled to pass an examination before three competent examiners before they should receive a licence, and that (with the exception of coasters under 70 tons burthen, and perhaps, an abatement in favour of steamers) the payment of pilotage be compulsory on all vessels, as it is in the ports of London, Liverpool, Hull, Glasgow, &c.

CHARTS.

Another point of importance that requires to be noticed is, the inaccuracy of the charts in general use on board merchant vessels with respect to the position and character of lights, buoys, beacons, &c. All, without exception, are faulty, and all, if followed, are liable to lead a ship into difficulty. The defence set up for the wreck of the Great Britain steamer on the shore of Dundrum Bay was, that St. John's Light, placed two or three years previously, was not inserted in the most recent charts of the Irish Channel that could be procured at Liverpool. The same may be said of the charts of the coast of Scotland; in none that I have examined were the recently placed lights, buoys, &c., inserted, and in many instances the descriptions of the light were erroneous. Now, this is a serious evil; nor has the seaman any protection against it, and may not discover the error till he loses his ship; and yet it would seem to admit of an easy remedy. I would submit, then, that in a case in which the safety of life is involved, it would be proper to oblige all chart-sellers to warrant their charts corrected up to the latest

SCOTLAND.

date with respect to lights and buoys, under a heavy penalty. To enable them to do this the more readily, and in order to afford the public a test by which to try the charts they may purchase, the three Lighthouse Boards of London, Edinburgh, and Dublin, should be called upon to publish, or to cause to be published at a low price, an outline chart, giving the exact position and distinctive character of all lights, harbour as well as coast lights, &c., which should be kept corrected up to the latest date, and a copy of it sent to every port in the kingdom. I am aware that the Board of Northern Lights have this year, for the first time, published a list of the positions of the coast lights and buoys of Scotland; but this, although a step in the right direction, is not sufficient, nor does the list contain any of the harbour lights. The Hydrographic-office, of the Admiralty has, many years since, published a far more complete list of all the lights of the United Kingdom (as well as of the lights in every part of the globe), but for our own coasts this is hardly sufficient; the seaman, in doubt about a light, has no time to look for and consult a list; all must be clearly laid down on the chart before him if he is to derive benefit from it in the hour of need.

As a further means of making known any change in the position of lights, buoys, &c., a sufficient supply of the Trinity, and other Notices of such change, should be sent to all the custom-houses in the United Kingdom, and one should be given to each master of a vessel trading at these ports. It would be an additional security if the Custom House authorities were empowered to refuse the clearance to a ship till the master or his agent had signed a receipt for the Notice with his other papers. Trinity notices are now issued; but as a proof how little they are read or cared for, it was in evidence before the Lighthouse Committee of the House of Commons in 1845, that the master of one of the finest Scottish steamers trading to London was not aware of the change of more than a mile in the position of a light-vessel lying immediately in his track, and which he passed twice every week, until six weeks after it had happened, and then only accidentally. Nor is this, by any means, an uncommon occurrence.

SHIPPING DUES. It is necessary to remark, that in most of the smaller harbours in Scotland, and in some of the larger ports, a portion of the dues levied on shipping and shipments is still applied to municipal purposes, as lighting and paving the streets, instead of being devoted to harbour repairs, improvement, &c. The time would seem to be come when these dues, levied in most cases under ancient charters, should be applied to their legitimate use, and that the shipping interest should, at least, have the benefit of the dues they pay laid out in repairing and deepening the harbours, and in providing a safe place of shelter for a time of need.

TRAFFIC. Among other documents in the Appendix will be found a table of the arrivals at the several harbours and creeks, and of the number and tonnage of vessels belonging to each place. On comparing this with the apparently similar custom-house returns, it must be observed that these latter only comprise loaded vessels, and, therefore, exclude the greater number composed of vessels in ballast, coasters carrying stone and lime, passenger steamers, &c. It is, therefore, the returns of the several harbour-masters that really show what may be termed the movement of the port; and it will be seen that instead of the custom-house return of 26,478 vessels of 2,484,625 tons, the real number of arrivals during the year 1846 was 80,000 of 6,300,000 tons, more than one-half of which were steamers; and it is for this traffic, and an equal amount of sailings, that the harbour accommodation of space and wharfage must be provided and maintained. The total number of seamen in Scotland would appear to be about 40,000, not including 41,000 men and boys employed in the fisheries.

TIDE GAUGES. Generally speaking, too little attention is paid to the phenomena of the tides in Scotland. With the exception of a self-registering tide-gauge at Granton Pier, there is no proper register of the tides kept in any of the harbours; the best, perhaps, is at Leith, but even there there are no means of measuring the height of low water, and thus the range of tide is unknown, except from occasional sets of observations made for special purposes, as by the Admiralty surveyors, or the well-known experiments of Mr. Russell, on the velocity of the tidal wave on the Clyde, or by the Messrs. Stevenson, in their admirable nautical surveys of the upper part of the Tay, and of the Firth between Alloa and Stirling. Dependent as every harbour is for its existence as a harbour on the daily ebb and flow of the tide, it would seem desirable that more attention should be paid to tidal phenomena; and as self-registering tide-gauges, including a clock, can now be fitted for the small sum of 30*l.* each, and as such instruments are already established on the east coast of England, at Scarborough, Hull, Harwich, Ramsgate, and Sheerness, it might not be too much to expect a similar outlay for this purpose from some of the wealthier ports in Scotland.

STEAM DREDGE. In the improvement of harbours there is no single measure that has been attended with such beneficial results as the free use of the steam-dredge; in nine cases out of ten this is the grand cure for the general evil complained of, namely, want of depth. But the outlay required for the purchase of such a vessel is more than the revenue of the greater number of harbours can afford; they would, however, cheerfully pay for its use, and for fair wear and tear, if the loan of a steam-dredge could be obtained from Government. The use of three or four such machines for a few years would be sufficient to deepen all the harbours in Scotland; nor would it be easy to point out how a greater benefit could be obtained at so small a cost.

SUPERVISION. With reference to the opinion, expressed in the course of our inquiries as to the necessity of some general and independent control over the harbours of the United Kingdom, it is right to state that the Collectors of Customs and Lloyd's Agents throughout Scotland were, almost to a man, in favour of such a measure, supporting their opinions by additional facts and argu-

SCOTLAND.

ments derived from their local experience around the coast. Of the 32 harbour-boards, town councils, &c., who gave an opinion on the subject, 15 were in favour of the proposed principle, and 17 decidedly opposed to any control over their proceedings. As a summary for Scotland, it appeared that of the 92 corporate bodies, shipping companies, and individuals who expressed any opinion for or against, 66 were in favour of the principle of supervision recommended in the First and Second Reports of this Commission, and 26 opposed to control *in toto*.

PUBLIC MONEY.

It appears from Parliamentary Returns that the only public money laid out in the several harbours of Scotland (besides the "deferred" quarter of a million before mentioned, at Leith) has been 50,000*l.* out of the balance arising from the Forfeited Estates Fund, about 11,000*l.* contributed by the Convention of Royal Burghs, and about 45,000*l.* expended since 1830 by the Board of British Fisheries. This last-named grant, which has been met, generally speaking, by a similar sum contributed by the local interest, has been of great benefit. It is hardly credible that the small sum of 2500*l.* a-year devoted to building piers and harbours should have given so great a stimulus to important local improvements as these grants are found to have done. Even the trifling aid of furnishing a plan or survey has often induced parties to begin improvements which otherwise might have remained for years untouched.

HARBOUR BILLS.

The Commission have found, in every place they have visited, a strong interest excited in the objects of their inquiry, and almost an universal desire to see the harbours improved, and where there was no harbour, to have one formed, however small. There exists a general belief along the coasts of every part of the United Kingdom, that fishing would be promoted by the formation of piers and harbours for the safe landing of cargoes, and for affording shelter in the sudden gales which are characteristic of these northern latitudes; and the local interests would often be combined and exerted to have piers erected, or harbours improved, if authority could be obtained to enable them to do so without expense in procuring that authority. The expense of obtaining an Act of Parliament has generally been so heavy, that persons convinced of the great advantage that would accrue to the local and general interests of the country from the erection of piers and harbours have been deterred from applying for authority by the dread of Parliamentary expense. It is therefore strongly recommended, that when Harbour Bills are introduced into Parliament by parties who are to act as trustees for the public service, and without profit to themselves, these Bills, having received the sanction of the Admiralty, should be considered as Public Bills, and passed through Parliament free of expense, as Highway Bills now are. But a better plan for the encouragement of the erection of piers and harbours would be to authorise the Board of Admiralty, after due investigation under the Preliminary Inquiries Act (which has been found to answer so well), to give their sanction and authority to any party or corporation to erect such piers, or to make such improvements as they consider proper, by the adoption of a general Bill for harbours and piers, such as are in operation for other public works under Her Majesty's Commissioners of Woods and Forests.

HARBOUR DEBT.

From what has been stated in the course of this Report, it will be manifest that the heavy drawback to improvement of the several harbours is the amount of debt due by greater part of them, and the high rate of interest paid for it. From returns printed in the Appendix, it appears that the aggregate revenue of the ports in Scotland is 192,000*l.*; of this sum 72,000*l.* arises from dues on shipping, the remainder, or 120,000*l.*, from dues on goods. It further appears that the aggregate debt of the harbours is 1,535,750*l.* sterling, the interest of which, at 5 per cent., is 76,787*l.*, or considerably more than one-third of the whole harbour income, which must be annually appropriated for this purpose, and thus materially cripple the means for future improvements.

This large sum, although borrowed with the sanction of the Legislature, has been laid out entirely by the several local boards, without the slightest control being exercised over it, either by Parliament or by any other power specially charged to watch over the interests of the public.

When the greater part of the works were undertaken for which this debt has been incurred, there was a fair prospect that the increase of dues would have enabled the several trusts to meet their liabilities without pressing too heavily on their funds. At that time the competition which has recently arisen between coast-railroads and shipping could not be foreseen; now, however, it is fully established, and it is to be feared that unless some measure be taken to relieve the pressure on the harbour revenues, and thus to enable the dues to be lightened, a large portion of the goods which coasting-vessels now carry will soon be conveyed by railroads, rapidly extending to almost every part of the coast; whereby the shipping dues will decrease, and the harbours must deteriorate. The measure that was most frequently urged upon us in the course of our inquiry was, an earnest request that in the same manner as advances under the Drainage Act have been made by Parliament to the landed proprietors of the United Kingdom, Her Majesty's Government would consent to advance money, at a low rate of interest, to pay off the Harbour debt in all those cases in which, on due inquiry, it could be shown that the debt had been contracted in carrying out works which may be fairly considered as public improvements.

JOHN WASHINGTON,
Examining Commissioner.

London, August 1, 1847.

APPENDIX C.

LEITH.

APPENDIX C.

LEITH.

No. 1

Evidence taken on the 5th Oct 1846

No. 1.

Examining Commissioner—Captain WASHINGTON, R.N. F.R.S., assisted by Captain VETCH, R.E., F.R.S., Admiralty Engineer.

Present:—Provost HUTCHISON, of Leith; G. WAUCHOPE, Esq.; Captain FRASER, R.N.; R. MOWBRAY, Esq.; R. LAURIE, Esq.; J. DUNCAN, Esq.; W. MUIR, Esq.; Captain ARROW, R.N.; Lieutenant THOMSON, R.N.; J. SMITH, Esq., Master of Trinity House, Leith; Councillor CAIRNIE, Newhaven, a pilot; D. THOM, Esq., merchant; J. HARDIE, Esq., shipowner; J. HUTTON, Esq., merchant; J. MITCHELL, Esq., Belgian Consul; R. PHILIP, Esq., merchant; T. DOWIE, Esq., Manager of London and Leith Shipping Company; Messrs. THOMSON and WATT, Agents for London and Leith Old Shipping Company; JOHN GILLON, Esq., merchant, &c.

Mr. PHIN, S.S.C., Clerk to the Commissioners for the harbour of Leith, examined. He described the various charters and Acts of Parliament under which, from 1603 to 1825, authority was given to the provost and magistrates of Edinburgh to levy rates and to borrow money for the purpose of making new docks, drawbridges, &c., in connexion with the harbour. Up to 1825, the total amount expended on the docks was about 300,000*l.*; and in that year an Act was passed, enabling the Treasury to acquire part of the west dock for a naval yard, in consideration of which they advanced a loan of 265,000*l.* at 3 per cent. In 1826 an Act was passed which took the management of the harbour from the provost and magistrates of Edinburgh, and vested it in 21 commissioners, nine of whom were appointed by the city of Edinburgh, nine by the public bodies in Leith, and three by the Lords of the Admiralty. The city of Edinburgh, in addition to being represented at the Board of Commissioners, were authorised by this Act to exercise a certain control over the expenditure; which control extended to the length of preventing any sum above 2000*l.* per annum from being expended without their authority. Under this Act of 1826 several important improvements were carried out, such as the extension of the eastern pier, according to the plan of Mr. Chapman, and the formation of the present west breakwater. In 1838 the present governing Act was passed, which secured the debt on the harbour to the Government and the Town Council of Edinburgh. By this Act the Government debt was postponed, while that due to the city of Edinburgh was secured by an annual payment of 7680*l.*—2000*l.* of which went to the support of the ministers of Edinburgh, 3180*l.* to the creditors of the city, and 2500*l.* for the purposes of education. The number of the Board was limited by this Act of 1838 to eleven Commissioners—five of whom were appointed by the Treasury, three by the provost and magistrates of Edinburgh, and the same number by the civic authorities of Leith. The Town Councils of Edinburgh and Leith could not elect any of their own members to be Commissioners, but otherwise there was no restriction under the present Act as to who should be appointed. By the previous Act, however, there was a certain qualification by payment of shore dues. This mode of electing the Commissioners seemed to give general satisfaction to the public, at least he received no complaints regarding it. The Commissioners held stated monthly meetings, besides special meetings. There were also meetings of the standing Committees; the number of which generally held in the course of a twelvemonth would be about fifty, although in one year there had been as many as 127. Of the eleven Commissioners, only one was a sailor, and that was Captain Fraser. There were several shipowners, however, in the Board.

The minute-books having been presented for examination—

The COMMISSIONER.—As far as a cursory inspection will enable me to judge, the minutes of the Board are carefully kept and duly signed.

Mr. PHIN.—The accounts at the end of the year were made up by Mr. Sandeman, the collector, and sent with the vouchers to an accountant. They were then made up under proper heads, and submitted to the Queen's Remembrancer in Exchequer for his approval, after which an abstract of them was printed, which any person could get by applying at the Shore Dues' Office. Every year a scheme and estimate of the probable expenditure were laid before the Treasury; and as the Queen's Remembrancer had this scheme before him when he checked the accounts that followed upon it, he had it in his power to refuse to docquet any amount expended contrary to it.

The COMMISSIONER.—Suppose 500*l.* were voted away for any purpose not connected with the harbour, would that be disallowed?

Mr. PHIN.—Yes; in fact, so minutely were the accounts checked, that a small sum of money which had been paid to complete the salary of one of the clerks, who had died, up to the end of the quarter, was challenged. Mr. Phin then showed that by the existing Act they were allowed to borrow a sum not exceeding 125,000*l.*; and, in order that they might be enabled to give a preferable security, Government had postponed their claim. No part of this money had been borrowed. Anything which had been done to the harbour, since the Act of 1838 came into operation, had been paid for out of their own revenue. He then mentioned that no works could be undertaken without the sanction of the Treasury; and, on being asked whether this mode of submitting everything to the Treasury had worked well, he replied, that while the Harbour Commissioners had never had any actual difference with their Lordships, they were convinced that without such control they might have gone on much more rapidly than they had done with their improvements. The Treasury never interfered in mere local affairs, but once or twice they had asked for explanations regarding certain items.

COMMISSIONER.—Now, suppose this control, instead of being vested in the Treasury, had been vested in a special Harbour Conservancy Board, would it not have been more for the advantage of the port of Leith?

Mr. PHIN, in reply, stated that the outline of the Conservancy Board to which the Commissioner had alluded had been laid before the Commissioners, and on which they would report; but, in his opinion, it, in some matters, interfered to a greater extent than the Treasury. As regarded facility, however, he admitted that such a board would be an improvement. Mr. Phin then stated that Mr. Walker and Mr. Cubitt, the engineers, had been divided in opinion as to the mode of improving the harbour; but

APPENDIX C.

LEITH.

No. 1.

Evidence taken on the 5th Oct. 1846.

as matters could not rest in their present state—there being constant and well-grounded complaints as to the want of berthage and dock accommodation—the Commissioners had made a renewed application to the Treasury on the subject, and they had within the last few weeks sent down Mr. Rendel, the engineer, whose report was not yet published.—[See App. No. 21.]

Mr. SANDEMAN, the treasurer and collector of the revenue of the harbour, examined:—The sources of revenues were dock-dues, shore-dues, berthage, beaconage, anchorage, &c. The whole amount of revenue derivable from these sources amounted last year to 27,945*l*., being a very large increase over that of the former year. The revenue had, in fact, increased very much within the last few years, chiefly from the importation of corn. Ten years ago it only amounted to 20,000*l*. or 22,000*l*. The table of shore-dues was drawn up in 1788; and any person who wanted a copy of it might get it. The shore-dues were all levied in Scotch money, which was very inconvenient to foreigners and strangers who came into the port. Some three or four years ago it was intended to apply to Parliament for a new table of dues; but it met with so much opposition from various parties in Leith, that the attempt was abandoned. A modification of some of the rates was very desirable. The dues on shipping are high, the dues on goods are low.

Mr. PHIN.—In proof of this it may be stated that some goods which were only worth 20*l*. paid as high as 3*s*. 6*d*.; while others worth 100*l*. were only charged 5*d*.

Mr. SANDEMAN.—There were also three different rates on vessels, in place of which it was desirable only to have one rate. Complaints as to these matters were frequently made, all of which were brought before the Harbour Board. The cost of collecting the revenue amounted to 763*l*. per annum, or about 2¾ per cent. on the sum collected.

The COMMISSIONER, having inspected the treasurer's books, said, as far as a cursory inspection would enable him to judge, the collector's books were kept in a business-like manner and did Mr. Sandeman great credit.

Mr. PHIN stated that the expense of obtaining a private bill, without any opposition being made to it, would amount to between 500*l*. and 600*l*.; and to go to Parliament with the chance of opposition would perhaps involve an expenditure of 2000*l*. It was the fear of this which, to some extent, prevented the Harbour Commissioners from proceeding two or three years ago with the bill to modify and equalise the rates.

The COMMISSIONER said that this would be prevented by the proposed Conservancy Board, which would carry all such bills through Parliament without costing the Harbour Commissioners anything; and this, he thought, Mr. Phin must admit to be another improvement which the establishment of such a board would effect upon the present system.

Mr. LESLIE, engineer to the Harbour Commissioners, examined:—He explained the different plans which had been set on foot, from that of Whitworth in 1786 downwards, to improve the harbour, and to build and extend the docks. Mr. Rennie's plan in 1797 for building the present docks was to carry them all the way west to Newhaven, making the principal entrance at that place, with an entrance for smaller vessels at Leith. The present docks were finished in 1817. Nothing was done after that till 1829, when the east pier was begun, according to the plan of Mr. Chapman, modified by Sir John Rennie. Mr. Chapman's plan was to form a substructure of stone, with a timber building above; and his idea was, that the sea would wash over this stone building for the purpose of scouring the fairway or channel. The Government built the west breakwater under Mr. Chapman's plan, which was a very useful work. Before the eastern pier was built, there was a weir extending 1000 feet from the old lighthouse. The channel formerly ran to the eastward, and the object of the weir was to change the direction of the channel and make it straight. The pier was carried out 1500 feet exactly in the same line as the old weir. The work remained in that state till within six years ago, when about 1000 feet were added to it; so that its entire length was now 2500 feet. There was a plan which had been proposed by himself to run the pier out another 1000 feet, which would give them 7 feet 6 inches at very low ebbs, or nearly the same as at Granton Pier. The great object which they would accomplish by this improvement was a low-water pier, which they had not at present. This plan could easily be carried out, as piles could be perfectly well driven into the sand; while the end of the pier would be formed of solid stone. This extension was absolutely required by the traffic of the port, as steamers, which would prefer coming into Leith, were obliged to go to Granton and elsewhere for a low-water pier. The cost of this extension would be about 30,000*l*.; and to carry out the pier other 250 feet, which would give them, by dredging a little, about two feet additional of water, would cost other 7000*l*., or 37,000*l*. in all. There was a good deal of drift sand came up from the eastward; but it was a doubtful question whether they were most troubled in this respect from the Forth or from the water of Leith. He had known some years ago of the river bringing down at a spate from two to three feet of deposit, partly from the rubbish which had been thrown into it after the buildings on Lord Moray's grounds. He did not think, however, that the average quantity of silt brought down by the river would amount to more than six inches in a year. There was no proper check upon people for throwing rubbish into the river, and he considered that such a check was much wanted.

The COMMISSIONER mentioned that there were powers in the proposed Conservancy bill to check such a nuisance.

Mr. LESLIE.—Many schemes had been suggested for widening the dock-gates. Their present width was such as to prevent steamers and large vessels from getting into them. This was a great want in Leith, as steamers were obliged to lie aground in the bed of the harbour, where they ran great danger of being strained and otherwise injured. He did not think it would be expedient to incur the expense of enlarging the present dock-gates, as the docks were so small; and he considered that there would be no difficulty in forming new docks in the outer harbour; indeed, they had got one of the walls built there already. He was of opinion that docks might be built there at an expense of less than 100,000*l*. Their area would be equal to their present docks—about ten acres and a half—but their depth would be about two feet and a half greater, while their entrance would be made 55 or 60 feet wide. He did not think that it would be worth while to make a western entrance to the docks, because they would not get a sufficient depth of water. He reckoned this the most proper time to prepare the plans of the proposed new docks, but, perhaps, not the best time for going on with them, owing to the high rate of wages. There is a weir at Leith mills which stops the tide, which would otherwise flow half a mile higher up. Mr. Leslie then showed the great want of a patent slip at Leith, on account of which steamers and large vessels were obliged to be taken, at great expense, to Dundee and other places to be repaired. He thought that a site might easily be got for

APPENDIX C.

LEITH.

No. 1.

Evidence taken on the 5th Oct. 1846.

such a slip. He did not think that the low-water mark had either advanced or receded in consequence of the extension of the piers, but that it was the same it was a century ago. There was no bar, in the proper acceptation of the term, across the harbour. There was, however, a sort of inclined plane. He did not consider that the building of the harbour at Newhaven or the pier at Granton had made any alteration on the harbour at Leith; in fact, he said, a vessel could come in now drawing 2½ feet more water than formerly.

Captain ARROW, R. N., examined:—He maintained, in opposition to what was stated by Mr. Leslie, that there was a bar across the harbour. If there was no bar, he would ask how it was possible that vessels could not get over it. This bar, he said, was formed partly by the sea, and partly by the silt brought down by the river. Captain Arrow complained that Captain Knight, Captain Boswall, and himself, had been summarily turned off the Harbour Commission by the Admiralty without any reason being assigned. He suspected, however, that the cause lay in this—that they, as nautical men, had differed with the other Commissioners about these improvements. He was of opinion that they would do a great deal of good to Leith if they would make a western entrance to the docks, and carry out old Mr. Rennie's plan in preference to those of the other engineers. He concluded by stating that a time-ball was much desiderated, and might be erected on the Calton Hill—a situation which would render it available to commanders of vessels for regulating their chronometers, and also to the public of Edinburgh and the adjoining districts.

The COMMISSIONER stated that he had experienced the want of a time-ball himself on the occasion of the Queen's visit to Edinburgh, and the Board of Admiralty, he believed, would erect one, if it could be shown that it would be attended with advantage.

Mr. LESLIE explained, with reference to Captain Arrow's statement respecting a bar, that the appearance of a bar was caused by the dredging and deepening inside, not by any shoaling outside.

Mr. DALL, Harbour Superintendent, testified to the great want of dock accommodation, and corroborated all that had been said upon that point by Mr. Phin and Mr. Leslie. So difficult was it to obtain good berthage that he has known vessels lying across the docks from side to side; but in general they lay four and five abreast. Dredging is carried on in summer; the dredge is of 16-horse power, and cost 7000*l.* in 1827; it cuts both sideways and forwards; the length of the dredging frame is 52 feet, with 30 buckets; and can lift on an average 30 tons an hour; we begin working when she floats at 6½ feet, and can dredge till the water rises to 15 feet. There are eight punts, and the soil dredged up is deposited to the eastward of the pier. Dredging costs 10*d.* per ton—about 2000*l.* a-year. The annual deposit is about 6 inches in the docks, and 9 inches in the harbour. We raise about 50,000 cubic yards, or 65,000 tons, a-year. The harbour has been deepened 3½ feet since 1826, and in consequence it has been necessary to underfoot all the quays from 3½ to 5 feet, and at the old pier 7 feet. Proposed the crossweir building to the eastward of the pier to the Harbour Commissioners in 1843; it is built of rubble-stone, and is intended to prevent the drift sand coming into the harbour. About 1000*l.* a-year is spent on it. Approves of the outer harbour as a site for docks. Steamers, as well as all other vessels, pay dock-dues for eight voyages in the year, although they cannot enter them. Owners complain very much of their lying aground and straining. Is of opinion the eastern pier should be extended into 12 feet depth at low water. Steamers from Leith are now obliged to go to a neighbouring port, and there, oftentimes, cannot get alongside the pier. The sills of the docks, in 1844, were lowered 15 inches, to the level of the inverted arch of the lock; they are now about 6 inches above the level of a very low spring tide.

In an easterly gale vessels anchor under Inch Keith, or run up to St. Margaret's Hope; but lights to enable vessels to do this with safety are wanted on Inch Colm and Inch Garvie. Vessels have been wrecked on the Oxscar by night; there is a general complaint of a want of lights; ships do constantly run up by night, and will continue to do so as long as there is a good harbour to run for at St. Margaret's Hope; and instead of laying out hundreds of thousands of pounds to make harbours of refuge elsewhere, the expenditure of two or three hundred pounds only in lights in the Firth would be of equal benefit. Is of opinion that the coast-lights generally are brilliant and efficient, but is not sure that there are enough of them; for instance, a light at St. Abb's Head would be a great benefit. Off Elie Ness, too, a beacon is wanting; the Ben Ledi steamer ran aground there; the Bloe Rock has only 17 feet on it. The time-ball was much needed; and he concurred in thinking that the Calton Hill was the best place on which to erect it, as it could easily be seen from the tops of the vessels in the harbour of Leith, while it could be seen to still greater advantage from the roads. He coincided in opinion with Mr. Leslie as to the extension of the east pier.

Mr. R. PHILIP, merchant, complained that no proper application had been made to the Treasury, or the requisite improvement would have been carried out; estimates were made and nothing was done; 7000*l.* would have laid down a patent slip, which was much wanted; but in consequence of a difference of opinion among the Harbour Commissioners, nothing was done.

Mr. T. DOWIE, Manager of the London, Leith, and Glasgow Shipping Company, stated that if there was accommodation given at Leith, so that all the steamers could land and embark their passengers within two hours of ebb or flowing, together with their cargoes, a revenue of about 5000*l.* or so might be realized for that accommodation, that at Newhaven pier, outside of the East Bush, there was about 9 feet at low water, while there was little or no water at the end of the present extended pier at the same time; that there was no accommodation for repairing large ships; and that if one of Morton's patent slips was erected at the top of Menzies' ship-building yard, it would save the owners of large vessels a considerable sum, and give employment to the mechanics of the town, the owners being obliged at present to send their ships to Dundee or London for repairs. In his opinion, the way to get a deep-water harbour would be, to run out the pier at Newhaven (which now belongs to Leith) beyond the East Bush, to get 13 feet at low water; and to carry a pier, or breakwater, from the end of the present wet docks westward, with good quay-room, would be the means of giving the accommodation required, not only for steamers, but also for large vessels frequenting the port. Has known large vessels lying in the roads for a week before they could get into the harbour even by lightening their cargoes. In corroboration of this, the large steamers that the company is connected with, which were got back to sail from Leith Harbour, are unable to do so regularly, even at high water (neap tides), and have been compelled to resort to Granton Pier; thus involving the company in double dues. The hardship is the greater to this company, that dues are exacted at Leith for the wet docks, although from the dimensions of the vessels they cannot get in there, and no accommodation is afforded. The fact is, the present docks are not capable of accommodating the trade; and if something is not done soon to improve the port, there is little doubt a part of the trade of Leith will be carried to Granton, when the Duke of Buccleugh gets his west breakwater made,

APPENDIX C
LEITH.
No. 1.
Evidence taken on the 5th Oct. 1846

which is to be commenced early next spring. From a little to the westward of the chain pier to the eastward of Newhaven stone pier, there has been no silting up: there is now the same depth of water at the stone pier as when it was founded in 1819. It is understood that the Dock Commissioners are to apply to parliament, next session, to have the dues of the port altered. If so, care should be taken that no rise is allowed, otherwise it will be against the trade of this place. The light-dues press very heavy; it costs the company 1800*l.* a-year for light-dues alone.

Mr. JOHN SMITH examined:—Has been Master of the Trinity House at Leith since 1830. There are 100 licensed harbour pilots at Leith, and about 60 sea pilots. The North Sea pilots are licensed as far south as the Downs, and round the north as far as the Isle of Man; but the greater part of the licences are from Red Head on the north to St. Abb's Head at the southern entrance of the Frith of Forth, and as far up the river as Carron Roads, and allowed on the pilots paying to the incorporation one guinea per annum while they hold their licence. The harbour pilots are examined by the Trinity Board before they receive their licences from the Dock Commission, which body they are under. There are 65 members in the Trinity Board, of whom 12 form a committee to examine pilots; they often receive complaints against the pilots, and he is compelled to add that the pilots are not what he could wish; he would prefer a better class of men. The Pilot Act is deficient; pilotage is not compulsory, nor for merely coming up the Frith as far as Leith he does not think it should be made so. Is of opinion that the harbour dues could be lowered with advantage to all parties.

Councillor CAIRNIE, of Newhaven, a pilot, complained that more men, and younger men, were not licensed as pilots; he did not see that a fine young man should be refused a licence because he had not served a certain time on board a square-rigged vessel; many a fore-and-after was as good a sailor as there could be. He stated too, that the Fishery Board had promised to build a boat-harbour, for fishermen and pilots, at Newhaven, but nothing had yet been done.

Mr. SMITH explained that by Act of Parliament the Trinity Board had no power to license pilots, except they had served two years in a square-rigged vessel. The income of the Board was 2675*l.* 13*s.* 2*d.* in 1845, and its expenditure 2238*l.* 6*s.* 0½*d.* Among other items of revenue was what is termed Prime Gilt, or a penny per ton on all goods imported into Leith, &c., which produces about 1090*l.* The services of the members of the Trinity House are entirely gratuitous; he had been re-elected Master and Treasurer thirteen times. With respect to the Dock Commission, he had been a Commissioner as far back as the year 1827, and until the passing of the last Act three of the Trinity Masters were always in the Committee. After being some time on the Board his opinion happened to differ from that of the Leith Town Council, and he and Mr. Robert Liddell received a very significant hint that if they did not vote as the Town Council wished they would be turned out at the next election; and in fact they were so. Witness makes oath that he voted independently, and, as he considered, for the good of the port; but, be added, sailors are at a discount in the Commission. It is his opinion, and, with one or two exceptions, that of the whole of the Trinity Masters, that the best low-water entrance to the docks would have been from the west, as originally proposed by Rennie; and had it not been from the greater influence of some individuals who had their property in South Leith, there is not the smallest doubt but that they would have bad their improvements carried out ere this. Is of opinion that it would be attended with great benefit if the monthly meetings of the Dock Commission were open to the public.

Mr. J. MITCHELL, Belgian Consul and an extensive timber-merchant:—Confirms Captain Smith's statement that he and his colleague were turned out of the Commission because they voted independently. States that the western part of the Queen's Dock, built for the accommodation of the port, is used for nothing; it was for 20 years in possession of the public, and is now occupied only by pleasure yachts, and occasionally by revenue cruizers while they are refitting; and at the same time vessels are lying four and five abreast in the other part of the docks, and all are crying out for want of accommodation. Not less than 75,000 tons of shipping have come in this year more than last; it would indeed be a great boon to the trade if Government would consent to give this space up to the trade till really wanted for government purposes, when it could be restored without the least difficulty.—[See App. No. 19.]

Mr. W. THOMSON, Mr. PHILIP, Mr. MUIR, Mr. MOWBRAY, Mr. DUNCAN, Mr. GILLON, and other merchants, all joined in expressing a wish that the Government would accede to this general request of the trade of the port.

The COMMISSIONER remarked, in conclusion, that the difficulties of a long, flat, fore-shore, drifting sand, and others which had to be encountered in improving the harbour, were certainly great, but not such that unanimity, skill, and perseverance might not overcome; and he expressed his regret that so few nautical men had attended the meeting; a circumstance which contrasted strangely with the numbers who crowded the rooms at Perth, Dundee, and Inverness.

No.
Return to Order of House of Commons of 9th August, 1844.

No. 2.

Return to Order of the House of Commons, of 9th August, 1844.

Edinburgh, 37, *Dublin Street*,
24th March, 1845.

SIR,

YOUR letter of the 1st ult. was submitted to the Commissioners for the Harbour and Docks of Leith; and by their intructions I now send you,

1. Plan and chart of the harbour and docks of Leith and the adjacent coast, corrected to 1843.
2. Plans and Reports, by James Walker, Esq., and William Cubitt, Esq., for the improvement of Leith Harbour, with Treasury Minutes, and other documents connected therewith; all dated in the years 1838 and 1839.

I have, &c.,

JOHN PHIN,
Clerk to the Commissioners.

The Hon. H. Manners Sutton, M.P.

[In this Return no mention is made of the titles of ten Acts of Parliament connected with the Harbour of Leith, nor of about twelve Engineers' Reports and Plans thereon.]

No. 3.

Report and Estimates relative to the Enlarging of the Harbour of Leith, with Plans of a Basin above Leith Mills, and another between the North Pier and the Citadel, with Sections of parts of the Work. By ROBERT WHITWORTH, *Esq., Engineer.*

Whitworth, on enlarging the Harbour.

MY LORD AND GENTLEMEN, *Edinburgh, 7th November,* 1786.

In obedience to your orders and directions I have taken a survey of the harbour of Leith, and have likewise taken the levels of all the adjacent country where there can be any probability of extending the harbour, supposing the entrance to be by the present pier, which, in my opinion, it ought to be; and I suppose it will be the opinion of all who are acquainted with the situation of the place and nature of this kind of business.

As it was once proposed to make a basin in the Links, I took the level of that ground, and found it from 7 to 10 feet above an ordinary spring-tide; so that, to make it to low-water, the mean depth of digging would not be less than 24 feet; consequently, to make a basin of any considerable dimensions would be exceedingly expensive, as the earth and till dug out must be carried to a considerable distance. Indeed the quantity would be so great that it would not be easy to find room to deposit it; but the greatest difficulty would be in making a canal of communication with the present harbour, as it would be between 500 and 600 yards long, and would, of necessity, pass through yards, gardens, and pleasure-ground, and would occasion many good houses and other buildings to be taken down. These are obstructions that did not exist, to the same degree, at the time it was formerly proposed (about thirty years ago) as they do now; so that, whatever it was then, it cannot now be an eligible scheme, especially as there are two others, either of them being, in my humble opinion, far more eligible, and of greater utility.

The one is, to make a wet basin in the low grounds to the south of Leith Mills, between the Bonnington road and the river; the other is, to make either a wet or dry basin upon the sands of North Leith; both which are represented upon the plan.

And, first, I will consider the proposition of making a wet basin in the low ground to the south of the river above Leith Mills.

Preparatory to the making a basin here it will be necessary to deepen the bed of the river, to give the ships a passage to it; and to give the better idea of the necessity and consequence of deepening it, and of the depth it ought to be made, I have taken the levels and drawn a profile of the bed of the river, from the point of the South Pier to the foot of the dam at Leith Mills; also of the bed of the river and ground above the dam where the basin is proposed to be made. The scale by which I have laid down the length of this profile is 200 feet in an inch, but the scale of height is only 20 feet in an inch, which it was necessary to do, otherwise the rise could not be made perceptible.

By this profile it appears that, if the deepening commences a little below the bridge, and be made to the depth of the red line, up to the lock that must be built to lift the ships into the basin, it would give about 7 feet water in ordinary neap-tides, and about 13 feet in ordinary spring-tides. This I would not propose to drive up quite level, but let it have a rise of about 1 foot in the whole space (which is about 600 yards): this would drain the water better from the workmen. Neither should it be dug to a flat bottom, but be made in the form of a segment of a circle, about 40 feet wide, and 2 feet deeper in the middle than at the sides. This would give the scouring-water from the basin a more powerful effect in cleansing out any sediment, gravel, &c., that may have settled in the channel, as it would confine it to a narrower compass.

There can be no difficulty in performing this part of the business, if you take the opportunity to do it in the dry part of the summer. At that time, I suppose, the water will not incommode the workmen very much in digging it up. Yet, if it be not very hard till, or rock, it may be cut by a ballast-machine at any time of the year, and at any time of tide.

As you have not given me any directions respecting the size it may be proper to make a basin for the reception of ships (supposing this scheme should be adopted), I have planned out as large a one as the low ground can well admit of; and this I have done in two different forms, but both of the same size. Each will contain about 35,000 superficial yards of surface-water, which is equal to 7·2 English acres, or 5·7 Scotch acres, which perhaps may be larger than there may at present be occasion for. But as the expense of deepening the river, erecting a drawbridge, and building a dock, to lift ships from the bed of the river into the basin, will be the same whether the basin be large or small, and as it will be necessary for me to have some data to build my calculations upon, I will, for the present, suppose it to be of the size I have represented upon the plan: but this you may reduce at pleasure; and, as it will be solid digging, the estimate of the expense will be reduced much in the same proportion.

In both these plans I have confined them to the lowest grounds as much as possible; a great part of which is very little higher than the dam-head, consequently must be marshy and of small value; but the part that would be covered with the earth dug out, and which must be occupied by the wharfs, warehouses, building-slips, &c., is for the most part good garden-ground.

In one of these schemes (represented by figure 1) I have proposed the basin to consist of a long square, about 450 feet by 300 feet, and of two branches of 150 feet wide each, the one 700 feet long, the other 450 feet.

This, I think, would be a convenient form for a basin, the two wings or branches being wide enough to contain four tiers of ships, and leave a commodious passage in the middle.

But if the expense of the quay or wharf walls be thought too much, they being near 1100 yards in length (exclusive of the dam-wall to separate the basin from the river), it may be made in the form represented by figure 2, which will be of equal capacity, and the expense of digging will be nearly the same.

The length of the quay-walls would be only 750 yards, consequently there would be a saving of 350 yards in length, which will greatly reduce the expense.

In both I have supposed them to be dug to the depth of 10 feet below the dam-head; so there would be 10 feet water, without the least interference with Bonnington Mill; and this may easily be done to this depth, as it may be drained (without pumping) by making a cut through the green, below the wash-house, and turning the river on the west side of the dam, and likewise paying the miller temporary damages during the execution of the work. Yet, perhaps, it may be advantageous to have more than 10 feet water. Suppose 12 feet be thought a proper depth, the easiest way to obtain it would be to pen 2 feet upon the tail of Bonnington Mill; for the earth, &c., dug out to make

APPENDIX C.

LEITH.

No. 3.

Whitworth, on enlarging the Harbour.

16 feet depth below the dam-head, will raise the ground sufficiently high for the quays; but if more than that depth be wanted, it would be best to take the water from the head of Bonnington Mill, by which 14 or 15 feet water may be obtained at the same expense of digging: but there will be damages to pay to the mills for loss of water. This I mention for your consideration; yet, in my calculations, I will confine myself to 10 feet deep, without interfering with Bonnington Mill at all: but I cannot steer so clear of Leith Mills; for the water to lift the ships out of the river into the basin must be taken from these mills. This has been mentioned as almost an insurmountable objection, as the whole water of Leith, in dry seasons, will not be sufficient for this purpose, and, of course, the mills rendered useless during those times of scarcity; yet, when the real quantity that may reasonably be supposed to be wanted comes to be considered, and in some measure ascertained, which I trust it may be, then perhaps this objection will not appear so formidable. Neither do I think it at all necessary to be at the expense of building both a large and small lock, in order to save the expenditure of water, but to build one lock of dimensions sufficient to take in the largest ships that it may be expected will be carried to this proposed basin. This, I suppose, should be about 130 feet long, and 34 feet wide

A lock of these dimensions will expend 123 tons of water for every foot of perpendicular height it lifts a ship. Now, a ship coming upon the top of an ordinary spring-tide will require to be lifted about 5 feet (see the profile), consequently will expend 615 tons of water. This is a quantity that will work an ordinary undershot corn-mill about nine or ten minutes (but as I did not measure the quantity the saw-mills take, I do not know how long it will work them); and this quantity of water would take one ship up and another down, or as many small vessels as the lock would hold. Vessels coming in or going out of the basin in neap-tides will require to be lifted or let down 11 or 12 feet; consequently, each lockful will expend about 1400 or 1500 tons of water. This would work a mill about twenty-five minutes. I do not know how many ships may pass in a day to and from the basin; but supposing there be three to pass up and as many down, in spring-tides they would expend about half an hour's water of a good corn-mill, and, in neap-tides, rather more than double that quantity; and, if the gates be kept in good repair, the leakage from them will be inconsiderable, so that the expenditure of water will not be so great as might have been apprehended, supposing the basin and gates be made water-tight, which I think there is but little difficulty of doing, though it has not been so thoroughly examined by boring as I could wish; but, from what has been done, it appears to be soft to 8, or in some places 10 feet deep, but in most places is hard firm ground a foot or two before it come to the depth the basin is proposed to be dug, so that there is great probability of having a good foundation for the quay-walls without piling, and that the digging will be easy. Indeed, the whole of this business will be easy to execute, as it may be so completely drained that the workmen will not be in the least interrupted by the tide, either in digging out the basin or building the quay-walls. But, in laying the foundation of the lock and the wing-walls below, the water may be troublesome and expensive, as the sill of the lock must be laid nearly as low as the bed of the river below the bridge; yet I do not apprehend much difficulty here, if the bed of the river be first deepened.

The dam or wall to seperate the river from the basin, I would propose to consist of two parallel walls, with cross or tie-walls between them at the distance of 30 feet; the space between them to be filled with earth, and that a part or rib about 3 feet thick in the middle of it be well rammed or puddled, and sunk into the natural ground, till it be incorporated with the earth, clay, or till below, so as to prevent any leakage.

A plan and section of this wall or dam, also a plan and section of the quay-wall, I have drawn at the bottom of the plan, to which I would beg leave to refer. These walls I suppose should be 6 feet thick at bottom and 4 at top, the front of the wall to fall back 2 feet, and to have a counterfort at the distance of every 30 feet, in each of which should be laid a tie of timber, represented by *a*, *b* (both in the plan and section), to bind the wall and counterfort together, to enable it the better to sustain the pressure of soft earth behind. The wall to be 15 feet high above the bottom of the basin, as the earth dug out will raise the ground to that height, and the whole height from the foundation may in general be about 16 feet. But this will altogether depend upon the nature of the ground, which is rather uncertain, as it has not yet been regularly bored; but if any part be soft where the walls are to stand, it may be made permanent and secure by piling, as represented upon the sections. The softness of the ground must regulate the length of the piles.

In the former part of this report I observed that the water necessary for locking the ships into and out of the basin must be taken from Leith Mills; and it perhaps may be thought proper to remove the mills altogether to the other side of the river (where there is a good situation for them), rather than they should work from the water of the basin, as navigators and millers seldom agree: yet I do not at present see any great objection to their remaining in the situation they now stand, and drawing the water of the river through the basin, provided there be a sill so placed that they cannot draw the water down lower than a certain number of inches that may be agreed upon. The only objection remaining would be the danger of the gravel and sand coming from the river and lodging in the west end of the basin; yet, if the sill of the sluice that feeds the basin be placed high, that is, two or three feet above the bed of the river, and in time of flood be close shut down, I do not think it would occasion much inconvenience—I mean, not enough to make it an object to remove the mills; for the little gravel or sand that might settle may easily be taken out with a small ballast-engine, without taking the water out of the basin. These objections being so far removed, I will suppose the mills to remain quietly in their present situation till it be found by experience to be more eligible to remove them.

Before I quit this subject of mills I will just observe, that, in case the water be penned 2 feet upon the tail of Bonnington Mill, in order to make 12 feet water in the basin, it will raise the head or fall of Leith Mills 2 feet, which would be greatly advantageous to them. But, if the water be taken from the head of Bonnington Mill in order to make 14 or 15 feet water in the basin, then the head of Leith Mills would be increased 4 or 5 feet, which would increase their power so much, that it would more than counterbalance any loss they might sustain in furnishing water for locking the ships up and down; in which case the compensation for water would entirely lie with the owners of Bonnington Mill.

This basin, I suppose, would conveniently hold 120 sail of shipping, and they would be well sheltered from the wind, so that they would be quite safe in the most stormy weather; and it is well calculated to scour out the present harbour, and deepen the channel over the bar. The way to give it the greatest effect would be to fill the lock, and discharge it from the lower gate, in which I would have six sluices, whose apertures, taken together, should be 36 superficial feet, consequently, would give a

APPENDIX C.

LEITH.

No. 3.

Whitworth, on enlarging the Harbour

column of water equal to 6 feet square; and this at the first setting out would be discharged with a velocity of 32 feet per second, which will give 1920 tons of water in a minute. But the mean velocity, during the whole discharge of the basin, will be 25½ feet per second, which will discharge 1530 tons in a minute.

The whole contents of the basin at only 10 feet deep (which, added to the height of the breast of the lock, gives the head upon which the foregoing calculations are made) are 87,500 tons, which, at 1530 tons per minute, will be discharged in 57 minutes.

This prodigious quantity of water, being let off about an hour and a half below low water in spring-tides, will most powerfully and effectually scour and cleanse the bed of the river from the tail of the lock to the point of the south pier. To this place it will be confined to a narrow compass, which will give it great effect; but from hence it will have liberty to spread, by which it will lose a great part of its power before it reaches the bar; yet, by making use of a ballast-machine or some other means to cut away the obstructions, it perhaps may be in some measure confined in a proper direction; which if it can, it will soon make an alteration in the depth of the channel at the bar; at least, it is the most likely way to effect it; but as I did not go out in a boat to examine this part minutely, I cannot just now say what method may be most proper to be taken.

The expense of making the above-mentioned basin and the other work described above may be nearly as set down in the following estimate:—

An Estimate of the Expense of making a Wet Basin in the Low Grounds between the Leith River and the Bonnington Road, on the South side of the Leith Mills, to contain 35,000 *superficial Yards of Surface Water, or a little more than Seven English statute Acres: Also, Deepening the Bed of the River, from a little below the Bridge to the Dam above the Mills, to the Depth represented upon the Profile; and Erecting a Dock, to lift the Ships from the Bed of the River into the said proposed Basin.*

In this estimate I will confine myself to ten feet depth of water below the head or level of the present dam, and to the form represented by fig. 2 in the plan.

	£.	*s.*	*d.*
To 178,520 cubic yards of digging to form the basin, including the foundation of the quay-walls, and also the foundation of the dam-wall that is to separate the basin from the river. This, as far as has been discovered by boring, appears to be soft and easy to dig to within two or three feet of the bottom, and then some of it will be hard till. I suppose one half of it will be dug and wheeled to a proper distance for 4*d.* per cubic yard; but in digging the bottom part, as the workmen may be a little troubled with water, and some of it will be till or some hard matter, it may cost 6*d.* per cubic yard: therefore the mean price is 5*d.* per cubic yard, which comes to . . .	3,719	3	4
To building 750 yards running of quay-wall, which at a mean will be about 16 feet high, 6 feet thick at bottom, and 4 feet at top; this will contain 277½ roods (of 24 cubic yards each). The face of this wall to be rough broached ashler, with bond-stones, of 3½ feet long at the least, at the distance of 8 feet in every course; the inside to be rubble-work, with headers to overlap those in the front ashler, with a coping 4 feet broad and 9 inches thick; the whole to be set in mortar. The price of this work in this country I do not exactly know, but suppose about 7*l.* per rood, at which rate it comes to	1,942	10	0
To 75 counterforts, such as represented upon the plan and section. In these there will be near 23 roods, which, including the timber-ties, I will suppose at the same rate per rood, which comes to	161	0	0
To building a water-tight dam, composed of two parallel walls, to separate the basin from the river, agreeable to the section before mentioned, drawn at the bottom of the plan (supposing no piles wanted). This wall will be about 164 yards in length, and will contain about 95½ roods of walling; which, at the aforesaid rate of 7*l.* per rood, comes to	668	10	0
To filling up the space between the said walls with earth, and incorporating the middle part of it with the natural earth, and ramming or puddling a rib up the middle of it (as represented upon the section), to make it completely secure and water-tight, which will be necessary; otherwise, when the basin is empty the river would break in upon it. This will require 2170 cubic yards; but as it will be dug out of the basin, it is as easy to bring here as carry anywhere else; therefore, there will be only the expense of puddling, which may cost 3*d.* per yard	27	2	6
To extra expense in making a sluice in the dam to let the water into the basin, and another to let it out again to the mill	60	0	0
To land that it may be proper to purchase for the basin, and likewise for wharfs, warehouses, ship-building, and other purposes.—What the proper quantity may be I am no judge of, but suppose the space contained within the red dotted lines, *a*, *b*, *c*, *d*, *e*, *f*, be sufficient, the quantity will be about 18 acres; about 6 acres of which is wet marshy ground, which perhaps may cost about 40*l.* per acre; the remaining 12 is good pasture or garden ground, which may cost 100*l.* per acre; at these rates, it comes to	1,440	0	0
To deepening the bed of the river, from the bridge to the proposed lock, in the manner before described, to the depth of the red line in the profile; also digging the foundation of the lock. In this work there will be about 8820 cubic yards, which, as a considerable part of it must be taken into barges (either by ballasting or otherwise), and carried away to some distance, it may cost 1s. per cubic yard, which comes to .	441	0	0
To building a lock, to lift the ships from the bed of the river into the basin. This, if built with wing-walls to the extent represented upon the plan and profile, with an inverted arch, will contain 165 roods of masonry, which, upon account of the situation, may merit about 10*l.* per rood.—Into this work I suppose it will be best to bring, and make use of, the materials of the old bridge, which will pay for taking it down and clearing out the bottom	1,650	0	0
To timber and iron work for the gates, &c.	440	0	0
To making a temporary dam to keep off the water, and pumping the water during the time of laying the foundation	200	0	0

APPENDIX C

LEITH.

No. 3

Whitworth, on enlarging the Harbour.

	£	s.	d.
To making a draw-bridge.—The most proper place for this bridge, I apprehend, would be at the new quay; and if it be made with an opening of 36 feet, with a 30 feet arch on each side, I suppose it will give sufficient water-way; yet, of this I am not certain: neither do I know what sort of foundation there is; therefore, cannot say with certainty what the expense would be; yet, from the rough calculations I have made, I suppose it will come to about	£1,500	0	0
To temporary damages to Leith Mills, which, of necessity, must be deprived of water during the time of the execution of the lock and basin, which, perhaps, may be two years; suppose	200	0	0
To loss of water after the works are completed, either to Leith or Bonnington Mills, or to both (see p. 8 of the preceding report); suppose	400	0	0
To impediments to works, unforeseen accidents, supervisal, &c.; also piling the foundation of the quay-wall and dam, if wanted (which is uncertain); suppose 10 per cent. upon the whole	1,284	18	7
	£14,134	4	5

I come now to consider the proposition of inclosing a wet dock or basin upon the sands of North Leith, by a pier from the end of the north pier to the east end of the citadel. This I have proposed to be built in form of the segment of a circle, struck with the radius of 1000 feet; this form will give it the greatest strength it can have, so as to enable it the more effectually to resist the violence of the waves, which will beat most furiously against it. By the trial that has been made by boring, it appears to be a good foundation of hard till, and, if built agreeable to the plan and section drawn at the bottom of the general plan, there can be no doubt but it will withstand the most violent tempests that can be expected to come against it. The worst thing against this basin is, its being exposed to the north wind; so that the light ships, being afloat in it, may lie uneasy and beat one against another in stormy weather: yet I should think a good deal of this objection may be removed by raising the parapet wall of the pier very high. I have calculated it to 16 feet above a spring-tide; but the form and strength of the pier are such, that it may with safety be raised to the height represented by the dotted lines, which is 18 feet above a spring-tide, or even higher if found necessary.

If this basin be made to the dimensions represented upon the plan, it will contain about 11 Scotch acres, or about 13¾ acres English; and this, I humbly apprehend, would be of more public utility if made into a wet basin; for this reason—because, if it be suffered to fill and empty itself every tide, it would in time fill up, or be greatly reduced in depth, by the foul tide-water dropping its silt and mud, with which it comes loaded: and there is no back-water to scour it out, nor can any be had, except by enclosing a part of itself, and making it into a wet basin to scour out the other part, in the manner that has been done at Ramsgate and some other places; and to keep this inner basin clear will be attended with a considerable annual expense: so that, upon the whole, it may be nearly as expensive as making a wet dock at once. To complete it in this manner it will be necessary to build a strong wall, parallel to the north pier, and the space between them filled with earth, to be incorporated with clay and till below to as great a depth as a trench can be dug; for the north pier is not strong enough to sustain the pressure of the head of water; neither can it be expected that the foundation is at all calculated for that purpose, if the pier itself was strong enough.

And, to make this work complete, it will be necessary to make a lock, or double pair of gates, to admit the ships into or out of the basin; for, upon the falling off of the tides after the spring tides, a single pair of gates cannot be opened till the water within be brought down to the level of that without, which would be attended with a good deal of trouble and inconvenience.

The expense of making this wet dock, or basin, may be nearly as follows:—

An Estimate of the Expense of making a Wet Dock, or Basin, upon the Sands of North Leith (containing 11 *Scotch Acres), in the Form represented upon the Plan.*

	£	s.	d.
To making a pier-wall from the north end of the north pier to the north end of the citadel, being 450 yards in length, agreeable to the plan and section drawn at the bottom of the general plan. This pier will contain 1140 roods of masonry, to be composed of large stones, such as is represented upon the section. The price of stone and labour in this country I do not exactly know, but suppose it may cost about 10*l.* per rood, which comes to	£11,400	0	0
To making an inner wall parallel to the north pier, at a proper distance, to enclose or contain a bank of earth to make it water-tight. This will take 92 roods of masonry, but will not require to be made in the same firm manner, or of such large stones, as the above; therefore it may perhaps be done at about 8*l.* per rood . .	736	0	0
To 44,660 cubic yards of earth, to be well rammed between the tie or cross walls that bind the parallel walls of the pier together, to be incorporated with the natural clay or till below, so as to make the piers completely water-tight, at 6*d.* per yard	1,116	10	0
To 4500 tons of whin, or any other kind of rubble-stone, to be laid upon the outside of the pier, in the form shown upon the section, to guard it from the violence of the waves; suppose at 1*s.* per ton	225	0	0
To making a quay-wall along the shore, about 7 feet below high-water mark, from the north end of the citadel to the east end of the north pier, being 380 yards in length, to be 16 feet high, 6 feet thick at bottom, and 4 feet at top, with counterforts at every 30 feet (the same as in the other proposed quay-wall); this will contain 152 roods, which, at 8*l.*, comes to	1,216	0	0
To digging and clearing out the sand to the depth of 12 feet below the high water of an ordinary spring-tide; in this there will be about 62,000 cubic yards of sand, &c., part of which to be wheeled to level up the ground behind the quay-wall, the other to be taken up into barges, and carried to the outside of the pier; this, if sand, will be done at about 3*d.* per cubic yard	775	0	0
To making a lock or double sluice, to enable the ships to pass in and out of the basin at all times when there is depth of water. This lock, if made with an inverted arch, will contain about 140 roods of masonry, which, at 12*l.* per rood, comes to .	1,680	0	0

APPENDIX C.

LEITH.

No. 3.

Whitworth, on enlarging the Harbour.

	£.	s.	d.
To making a temporary dam, to keep off the neap-tides during the time of laying the foundation and pumping the water	400	0	0
To timber and iron work	440	0	0
To unforeseen accidents, impediments to works, pile-engines, pumps, and other utensils, supervisal, &c.; suppose 10 per cent upon the whole	1,798	17	0
	£19,787	7	0

The above are the best calculations I have been able to make, from the imperfect knowledge of the price of the stone; and not being completely certain as to the foundation in every part. Yet, with regard to the proposed basin above Leith Mills, if I be right in the price of materials, I can speak with some kind of confidence that I believe the estimate will be sufficient to complete the work, it being a kind of work that I have been long acquainted with. But of the other proposition, of making a wet basin upon the sands of North Leith, I cannot be so certain, as it is altogether in the tide's way; yet it is so plain that I think I cannot be much mistaken.

I am, &c.

ROBERT WHITWORTH.

To the Right Honourable the Lord Provost,
Magistrates, and Town Council of the
City of Edinburgh.

No. 4.

No. 4.

Shirreff, on enlarging and improving the Harbour and Town.

Plan for enlarging and improving the Harbour and Town of South and North Leith, with Plans of Basins, Dry Docks, &c., for additional accommodation, by R. SHIRREFF.

MY LORD AND GENTLEMEN, *Leith, 23rd March,* 1787.

WHEN the proposal for enlarging the Harbour of Leith was first spoken of, and for long after, I thought that I should be no further interested than any other merchant, who, from their residence in the place, was to partake of that additional accommodation which the proposed scheme of enlargement might give. I had no doubt but such advice would be taken, and such plans produced, by those who had made that kind of business their study and employment, as would quite supersede the necessity of others offering the least additional aid. When I heard of a gentleman of approved ability being called from a neighbouring country, from the very midst of every information that extensive works of this nature could give, and who, from real practice, was fitted to give your Lordship and Council all the information you wished, which I know is only that which you hope shall be found in the most complete way to answer the accommodation of the increasing trade of the country, I was the more confirmed in my opinion, that anything occurring to such as me on the subject would be anticipated, and our feeble aid altogether unnecessary. I therefore, with many of my neigbour merchants, waited with anxiety to be favoured with the sight of a plan that was expected to answer all the ends of accommodation: and how soon the public was favoured with it, I got one in possession, which I found drawn with exactness; and however much some may have pretended to find fault with the estimate that accompanied it, yet evidently showed that it came from the hand of one well acquainted with the business of carrying on and executing such a work. Notwithstanding the care of your Lordship in employing one seemingly so very fit for the business, and however much attention Mr. Whitworth had given to the construction of his plan, it no sooner appeared than it was attacked with violence from every quarter; and such broadsides were given by those who are accustomed to that kind of attack, that I soon saw, instead of its tending to help the watery element, that it ran the the greatest hazard of being blown out of it altogether.

The indulgence given by your Lordship and Council to those gentlemen, for whose accommodation the proposed enlargement of the Harbour was chiefly intended, to give their opinions, and every necessary information in their power, was soon accompanied with declarations of their intended productions, which were at once to remedy every inconvenience in the plan produced by Mr. Whitworth, and answer every wished-for accommodation. I was now again led to think that observations on the subject from merchants would still be unnecessary; and although those from whom new plans were now to be expected had not the same practice nor knowledge in the business as the gentleman whose plan we had already been favoured with, yet, as more than one had voluntarily set to work, with a desire no doubt of serving the public, and others also with the additional hopes of succeeding in taking all merit from a plan which was by them treated with rather too much contempt, and of so effectually reaping a harvest of praise as to leave little or no gleanings to others, I therefore expected something might be thrown out by those who had thus engaged, and who, from the advantage of residence alone, should know better than any stranger could possibly do what was wanted; and that their hints, being added to what might be wanting in Mr. Whitworth's plan, would surely make the matter so complete that the most sanguine expectations would be answered; and after waiting with raised hopes and equal anxiety as formerly for the promised productions, I at last saw plans produced, leaving full room for ample improvements, and, as it appeared to me, equally neglectful of the accommodation that our trade in its most essential parts stood in need of, and containing errors less excusable from gentlemen who, from a long residence in the place, should have known better than a stranger what ought to have been avoided. I now stepped a little more frequently than formerly into the coffee-rooms, where those were to be found from whom plans might be expected, to know if anything further was to be had; when, hearing of different schemes, but which appearing to me so very distant from what was necessary, I was led to say, that I thought they had not yet bit upon what would answer, and that some ideas had struck myself, which I was convinced, if carried into effect, would be found to answer every accommodation our trade required, and be attended with less inconvenience than the plans as yet produced, which at this time were three, Mr. Whitworth's of the 7th November last, Mr. Scougal's of the 21st December, and Mr. Charles Henry Ker's of the 12th January. Being urged by the gentlemen then present to give my opinion, which being received with approbation, and being those whose judgment in that kind of business I respected, was thereby induced to lay down upon a plan of the town what occurred to me necessary for the needful accommodation of our trade, and which I had the honour of showing your Lordship and Sir James Hunter Blair a day or two thereafter; and also the happiness of making at the same time a survey of the

APPENDIX C.

LEITH.

No. 4.

Shirreff, on enlarging and improving the Harbour and Town.

ground on both sides of the harbour, thereby having an opportunity of showing that the particular situation of the ground greatly favoured my purpose in the enlargement of our harbour, the accommodation of ship-building, the improvement of our present quay, and the melioration of North Leith, &c. And from the very ruinous state of such houses as I proposed taking down, your Lordship and Sir James Hunter Blair seemed to be satisfied they were fit subjects for making way to the improvements I then had the honour of pointing out.

Having laid open my views on the subject, and made the survey as mentioned, I expected having nothing further to do in the business, resting fully satisfied, if any hint I had given would promote the public good, it would be adopted: and to those who had openly embarked in favouring the public with plans, I freely made my mind known, in order they might introduce what they thought of advantage, to which their after productions show they have not been altogether inattentive.—I offered it as my opinion, that your Lordship should make a gentleman, whose particular business it was to execute works of this kind, make out a plan from all the ideas that had been given, that those who either knew or thought they knew something of the business might employ themselves in pointing out its advantages and disadvantages, which might lead to the best plan, and one that in the end might be found to answer. Which proposal your Lordship approved of; and Mr. Whitworth having accordingly favoured the public with his remarks on all the plans in general excepting one, I am led, from that omission, to trouble your Lordship and the public with my remarks, which I do at the request of several gentlemen, with whose desire I am induced to comply, on account of Mr. Whitworth's saying, "Mr. Shirreff's plan is the same with Mr Gordon's, only more exceptionable, as it takes a deeper hold of the sea, and is therefore more difficult." This small notice of Mr. Whitworth's I call a passing by altogether, and only touching at a part which I hold of the least consequence, as it appears to me to be a part thereof which, although the most expensive, yet such as, if the other parts of the plan are complied with, the want of its execution will be the more easily put up with; although I do say, if the whole can be executed, will also be very acceptable for the accommodation of such ships as, from their particular construction and tender state, may be hurt by taking the ground in a dry harbour when loaded.

I am well aware of the hazard of my remarks, when I pretend to support a plan in opposition to one who has so ably pointed out the errors of others, and laid before us the unavoidable consequences of changing the course of rivers;—a consequence I evidently foresaw; and from the same opinion, when the particular survey of the grounds was made with your Lordship, I opposed the intended new passage which was then by some insisted upon, and observed, that should it be done, in a few years not a single ship of any considerable draught of water would enter your harbour. My acquiescence with Mr. Whitworth raises my hopes a little that I at least may be able to combat the matter with success against those gentlemen who have attacked my ideas much in the same way they have done his. But as I mean to go a little further, and even aim at the establishment of a plan quite different both from Messrs. Whitworth and Ker's, and also considerably differing from Mr. Scougal's last publication (which, notwithstanding his adopting a considerable part of what I pointed out, makes his last plan to come nearer what is wanted than his first), yet there is in it such a disposal of our present harbour, by carrying discharging quays so much above bridge, that I cannot allow myself to think it will be found convenient, and will prove such an inconvenience to ship-building (which ought to be accommodated in that part of the river) that I wish to guard against its full adoption.

I think Mr. Scougal's giving the least hint of a wet dock being made of our dry harbour, and omitting informing us where one ought to be if his hint should be rejected, are sufficient reasons for my endeavouring to support what I formerly pointed out, especially as he takes notice of a plan proposed by me, and says, "Can there be any comparison between the basin of Messrs. Whitworth, Shirreff, &c., and the one I have proposed, &c.?" By the observations I made, and plan shown your Lordship, being so frequently struck at in the eye of the public, before whom it was never intended to be laid, I am now under the necessity of defending it, and giving it a public support. And as I already noticed that I meant to go a little further than just to combat the matter against those who have attacked Mr. Whitworth, and even aim to establish a plan in opposition to his, I should be at a loss how to introduce myself so as to secure a favourable retreat in case of disappointment, if it was not for this consideration, that every attempt to serve the public, even however feeble in itself, is yet justifiable. An attempt to assist in a work of such magnitude, the good or bad effects of which will be felt by succeeding ages, is certainly to be commended, and carries its own excuse along with it, allowing it should fail of success; and my observations, I hope, shall be such, that if any notice is taken of them by Mr. Whitworth, it shall only be a return that brings along with it real argument; which is more than I can say for the returns of some others, whose strictures have been rather severe, and given in a language calculated rather to offend than convince.

Having mentioned my reasons for addressing your Lordship in this public manner, and finishing my introductory remarks, I shall now state what has occurred to me as to the enlargement of our harbour, &c., that the increasing trade of this part of the country seems to require.

In imitation of others, I shall endeavour to support what I advance, and then point out what I think objectionable in any other plans that have been produced.

The most regular way of doing which will be, in so many articles to state what is wanted; and the desirable objects seem to be—

1. An enlargement of our present harbour, so as to contain in a commodious way as many ships as possible.
2. The South Quay made broader; the narrowness of which has been long and justly complained of.
3. The melioration of North Leith;—a town that stands extremely in need of it, and is a side of the harbour at present of little use.
4. Full and sufficient room for ship-building; the want of which has long been severely felt, and by which the port has been much hurt.
5. A wet harbour, so situated as not to encroach on our dry harbour, but to prove a real addition, and to be made as large as the expenditure on the other improvements will admit of.
6. Additional roads and streets opened.

Some other things might also be noticed; but as the above six articles will take in the first and most necessary objects to be attended to, I shall at present satisfy myself with a few remarks on each. And for the first, an enlargement of our present dry harbour, &c., I observe, that the only way of obtaining sufficient room for holding, in the most commodious way, that number of ships that have of late years

No. 4.

Shirreff, on enlarging and improving the Harbour and Town.

been so crowded together as to endanger each other, and the harbour so frequently blocked up that they could not pass, is by making that part of the harbour broader where the ships mostly occupy, that is, from the Ballast Quay to the New Quay. There I have always observed the greatest crowd of shipping; the nearness to the entrance of the harbour, and the difficulty of getting large ships warped up, and the fresh in the river, that frequently makes it impossible getting farther, are the manifest reasons of that part of the harbour being always preferred. And as these reasons must always exist, I therefore think considerable attention ought to be given as to making the harbour in this place as commodious as possible; and which may be accomplished at no very great expense, by pulling down, I had almost said the remains of houses, but I may surely say property of very little value; as, from the ruinous state of which on that part of North Leith extending along this space, many of the houses must tumble down of themselves in a few years. There is indeed one or two houses that are in good repair, and of some value; but where are there, in any town, such a group of houses that will bow so easily to an improvement so necessary as their removal makes way for? The dry dock belonging to Mr. Sime, the most valuable and useful property, may perhaps be preserved, as there are a few old houses at the head of it, some of which I believe are not inhabited, that, by their being pulled down, will admit of the dock being carried considerably higher, although I am afraid it may still be found a little in the way. This enlargement of the harbour should be carried up pretty near Mr. Dryburgh's Dock, as the the harbour, in its extent from the Ballast Quay to Upper Dry Dock, requires to be made broader. Especially will this additional breadth be found necessary, as I intend to propose all building of ships to be above bridge; in the following out of which plan, room must be had for the many ships that will be frequently going up and down the harbour. I am the more willing to have this enlargement, as the houses on the upper part of North Leith that must be pulled down are still, if possible, in a worse state, and also considerable openings where are no houses at all. Those on the north side are evidently property of very little value, and stand in the middle of the harbour as a heap of ruins: their situation readily points out where an enlargement ought to be made; and am therefore surprised that it should have escaped the observation of most of those who have undertaken to write on the subject. Notice has indeed been taken of this enlargement, and other improvements I had the honour of pointing out to your Lordship, by a late publication; but how far they were hid from that gentleman's observation at the time I pointed them out as necessary and much wanted improvements, a plan produced, dated the 21st December last, will show; so that I am fully warranted to make the observation; and although I should also include that of making the South Quay broader, I believe it will be extremely difficult to find these improvements in any plan that your Lordship has been favoured with, till I led the way.

I perhaps had spared these observations, if gentlemen had been sparing in the use they made of the plan I had the honour of showing your Lordship, as one deserving of little notice, or such as to be ranked amongst those to be rejected. Respecting this enlargement, it only remains to be noticed, that the depth of ground that these ruinous houses occupy is very considerable, being not less than 248 feet. The main street of North Leith is from 25 to 30 feet wide; so that the extent to the water edge, including the street, is about 275 feet, which fully makes way for making the harbour double its present breadth, and gives ample room for every improvement it stands in need of, such as an increase of discharging quays, and that of making the South Quay broader, which, being the second thing mentioned, I shall now notice.

The very great inconvenience of our narrow quay has for long been justly complained of, and all have wished for its being remedied; some have even gone the length of saying, that the houses which form and front the quay should be purchased by the aid of Government, and carried from 30 to 50 feet back—a scheme at once equally expensive as ridiculous; for, not only must these houses which line and form this part of the town be pulled down by the expenditure of a great sum, but one equally great must be employed in pulling down those that are immediately behind, and having them rebuilt, as they will be found to stand in such an awkward way, that they, in their present situation, could never answer to form so principal a street. But I suppose those who thought of such a method of making the South Quay broader were led to the proposal from seeing the improvement absolutely necessary, and thinking there was no other way of obtaining it. But if the enlargement of the harbour, as already proposed, takes place, by taking down the heap of ruins on the north side, there will be full room to add 30, 40, or 50 feet, if thought proper, to the South Quay, and the harbour be still double its present width. I would propose this additional breadth to begin at the New Quay, and be carried down to the sweep of the harbour opposite to the Timber-Bush gate, where the quay is broad enough. And in order to reconcile to this alteration, I have further to observe, the quay, in that extent, in most places, is extremely needful of repair, and shows that it is ready for the alteration, which will be done at no very great expense, by removing the aysler that now forms the front of the present quay, as far out as thought necessary, and filling up with the clay and mud that will be necessary to be removed from the north side, which will deepen the harbour in that part, and prepare the way for an increase of discharging quays, which may be of equal extent on the north as well as on the south side of the harbour, and will greatly tend to the melioration of North Leith, which is the third thing proposed.

North Leith, from its situation, lying so as to have much of the sun in the most agreeable part of the day, if also laid open to the pleasant prospect of the ships going and coming in the harbour, and made commodious for the accommodation of shipping, would necessarily, in a few years, come to be a very different town from what it now is. This consideration alone is a sufficient reason for taking away the houses on the side of the town next the harbour, although they were in a much better state than they are, as it tends to meliorate the town so much, that it is evident the remaining part, in a few years, would be of more value than the whole as it presently stands. I therefore would propose that the harbour should extend so far on the north side that the present main street of North Leith should be a quay on that side, the same as the South Quay on the other side, and thereby have the houses in North Leith forming an agreeable line of front, looking to the harbour, which, with the discharging quay which this has already been proposed to answer, will be of so great an advantage both to the harbour and town of North Leith, that it appears unnecessary saying anything to enforce it. And I have only heard of one objection, which appears to me a most selfish one, but of which those who are most affected by that kind of spirit need not be afraid, as it will always be found the greatest number of ships will resort to the south side of the harbour. The objection is, "Do not encourage your trade to go to the north side." A thing that never will take place as long as the metropolis lies on the south side of the river, and the discharge is found to answer the conveyance of goods to the city better than from the north side. But when the south side of the harbour is fully occupied, and the

APPENDIX C.

LEITH

No. 4.

Shirreff, on enlarging and improving the Harbour and Town.

present discharging quays as much employed as they can be, where can be the objection of allowing the north side of the harbour to be made in such a way as vessels that cannot obtain a berth on the south side may there be accommodated?—especially as by such accommodation they may procure a quick despatch, which may be of the utmost consequence, not only respecting the cargoes, which may perhaps be of such a nature as a detention of a few days may much hurt, but also respecting the ships, which may have a voyage to enter upon when again ready for sea; and gentlemen in the sea line best know of what consequence a few days frequently are: a day or two of a fair wind that may offer, if embraced or lost, frequently makes a gaining or a losing voyage. It would surely be most agreeable to see the principal port of the kingdom (which that of the capital must always be reckoned) equally commodious on both sides; the town and country in general would reap the advantage. Every method should be fallen upon to increase the capital and its port, whose interest cannot well be separate; and the more their increase, the more their consequence and advantage to all. What is it that gives London all its weight and influence, but its magnitude, which will always be attended with a magnitude of trade? Some may think I have forgot how this last argument applies; that it rather strikes against my proposed plan of pulling down so much of North Leith. But my scheme of pulling down is to encourage a building up, and to prepare the way for that side of the harbour being able to receive the overplus of shipping which the south side is obliged to reject; the certain effects of which must be in a few years an increase of inhabitants, and an invitation for gentlemen of substance to place their attention on having proper houses built where at present there are very few, but where are agreeable situations of gardens, lying to the sea, where houses may be built fit for the accommodation of the genteelest families, and space sufficient to make the town much larger than what it now is. I am so much of opinion that the increase of inhabitants is of the utmost consequence to towns, if these inhabitants are properly employed, that I think every scheme that does not point to that object, and ultimately end in the establishment of manufactures and trade in general, for their support, is unworthy of attention; and I am surprised all the plans which have been produced have not had the increase and accommodation I point at more in their eye, so as to have made these objects the principal part of their attention—rather as a wet basin, in which they seem to have been so much plunged, that they thought other improvements deserving of but little notice. But as my observations of what is wanted in the port have not led me to think that a wet harbour or basin is of such mighty consequence, I have therefore not plunged so deep as to allow it to drown other objects. A wet harbour for large and tender ships, I have already said, is a desirable object, if it can be obtained; but as it is the most expensive part of all the plans that have been or will be produced, if placed where practicable and advisable to have it, I am happy, therefore, in adding (in which I believe many will be found to concur), that it is the part that can most easily be dispensed with, providing the present dry harbour is made more capacious, the South Quay made broader, North Leith made a discharging side, and proper accommodation given for ship-building; which last, being the fourth thing to be treated of, now falls under consideration.

The want of room for building of ships, and ground to lay up a sufficient stack of timber and plank for the purpose, has been so long and so severely felt, that I am really at a loss how to account for gentlemen, who, from long residence in the place, and who have thought so much upon the enlargement of our harbour for the accommodation of trade, so as to think their observations merited the attention of the public, have so much overlooked it, or only thought it a kind of secondary object; and how much it was in their eye before I had the honour of pointing out this necessary accommodation to your Lordship, most of the productions show. I have already noticed that Mr. Scougal's last publication pays some attention to this object: and Mr. Ker, in his reasons against placing discharging quays above bridge, takes notice of accommodation for ship-building, which he thinks necessary to advance as an argument against Mr. Scougal's plan; but of how little consequence this accommodation is with Mr. Ker, appears, by not giving it a place in his plan of town and harbour. In the other plans, little notice is taken of it; but, however much they have overlooked it, it has always been with me a principal object, as I am convinced nothing would tend more to increase our trade, and find employment for our ships and labouring people, than full and sufficient room for ship-building,—a branch of trade, which, as Mr. Scougal very properly says, "would prove a source of riches, and therefore deserving of particular attention."—The number of hands necessary for building, the many ships that are employed in bringing the materials, the weavers that are wanted for working the sail-cloth, and the increase of demand for those employed in making the cordage, with the great influx of trade from the importation of every article that an increase of ship-building would occasion, at once point out its consequence: and, for want of necessory accommodation in this line, the port of Leith has laboured under vast disadvantages for many years, which, unless remedied, must increase with the trade. Last year, Mr. Scougal himself was obliged to make application to the River Shields for the building of one or two large ships; and just now there is one building in the same river for a gentleman of Edinburgh; all of which, with many more, would have fallen to the ship-builders here if they could have undertaken them: and the gentlemen in that way tell me they are obliged to reject contracts from England that are frequently urged upon them, but which they have not in their power to embrace, for want of slips to build upon, and room to hold a sufficient stock of timber. The only way of obtaining accommodation for this very essential branch appears to be just what I formerly pointed out, namely, by making the present bridge across the upper end of the harbour a draw-bridge, purchasing the grounds on both sides of the river as far up as the mills, and that pointing downward on Hillhouse-field ground, which will make full room for as many slips as shall be wanted; and the Bowling-green Park, with Mr. Hill's garden, will give room for holding timber on the one side; and Mr. Chambers's parks, on the other side, will give as much as can be wanted, as the public road that goes along North Leith to the Ferry may be so disposed as to bound the ground where the building-slips will be placed next the harbour, and also serve for the conveyance of timber to the parks on the north end of Mr. Chambers's house, where there is such extent of gardens and corn-fields for laying up timber, that every inconvenience which in this way has taken place may be effectually removed; and in the neighbourhood of which, large and capacious dry docks may be formed, as pointed out by Mr. Scougal's last plan. The necessary room for laying up a sufficient stock of timber to enable ship-builders to embrace any contract of consequence must be much more than most think of. I suppose, to give all the gentlemen in the port in that way the room that may be required, not less than ten or twelve acres of ground are necessary; and there is no part near the river where that quantity can be so easily obtained, and that lies so contiguous, as the place pointed out, which forms, with me, one very material objection to the last publication, which carries dis-

APPENDIX C.

LEITH.

No. 4.

Shirreff, on enlarging and improving the Harbour and Town.

charging quays above bridge; as I am convinced, for the purpose of building of ships and boats, the whole sloping ground next the river on both sides will be found little enough; and this accommodation will be obtained at no very great expense, as most of what I have pointed out is not clogged with a heavy purchase of houses, few being on the ground; and all that is necessary respecting the river is only to clear it of stones, as no great depth of water is required for the conveyance of light ships, which makes the accommodation pointed out the more eligible.—Several other things might be noticed respecting the execution of this part of the plan; such as forming a narrow quay along North Leith Church property on the one side, and that of Messrs. Laurie Beaddie and Cundel on the other; the forming of which quays will take down none of their property, as it is only meant as a passage to lead from the present harbour to the building-grounds, and to be of use in assisting ships going up and coming down the river, for which there is sufficient room, without either touching these gentlemen's properties or coming in on the bed of the river. This is giving a compliance with Mr. Scougal's declared purpose of pulling down as little as possible of useful property; which, not being attended to by some who have produced plans, led Mr. Whitworth to say, with great justice, "That he could not at first believe there could be any serious intention, or even the most distant idea, that such should be offered to your Lordship and Council, for your consideration." But these quays, with other little improvements that will cast up in the prosecution of the work, will readily occur, and may be referred to be pointed out by a more particular plan than I have just now time for; and which I expect will be undertaken by your Lordship's appointment of Mr. Whitworth, or some other, who may be expected to do it with that accuracy their particular profession fits them for.

Having now said so much on this very essential article of the plan, I would willingly leave it, had not the late publication, and that of the 21st December, chalked out a dry dock quite in the way of the enlargement of the harbour, and also interrupts a new passage I propose to open for small craft getting readily out and in, when the main passage is interrupted with large vessels which may be going out or coming in at the same time. This dry dock is placed across at the upper end of the Ballast Quay, where the harbour is but narrow, and where ships that are taking the dock must both give and find considerable interruption. If a dry dock about that part of the harbour is found necessary, I would propose a more eligible place, and about which there is full room for timber that may be wanted by the ships that may there be hove in for repair; that is, on the west side of the sand port, where the plain and rough stone pier join, or a little higher up, if the deepening of that part of the harbour will admit of it. There is sufficient room for two docks, if thought necessary; and by opening the passage I mentioned, that the dock proposed by Mr. Scougal interrupts, at the upper end of the ballast quay, a run of water, in great speats, will find its way down that bank, and help to keep it clear, and considerably reduce the bank of sand that frequently collects there, so as to make many ships take the ground before they can be brought to their berths. This passage will be found extremely convenient for small ships; and the proposed enlargement of the harbour by the north side suits it much. The ballast quay must be kept as it now stands, to prevent the sea in the northerly winds running up the harbour, and for vessels in certain winds making sail from; but as it is of no other use, there can be no inconveniuence by the proposed passage separating it from the main quay on the north side.

Having now finished what at present occurs respecting the melioration of our present harbour, the south quay, North Leith, and the accommodation for ship-building, I come to the fifth thing mentioned, that of a wet harbour or basin. Here I must be particularly careful what is advanced, as I find it is the most hid and dangerous part. It is not only so from its nature, as all works that lead deep into the earth must be; but also from the vast expense that attends it, and the extreme keenness with which its situation has already been pointed out and supported. As the plans that have already been produced have set out with its being their principal design, and in which their merit seemed to be lodged, the touching of it is like touching the apple of the eye, most sensibly felt, and therefore to be done with caution. After all attention in my power being paid to the different plans that have been produced, I must be allowed to say, that I find myself still attached to that ground, which, upon my first outset, I pointed out to your Lordship as being the most proper and the most convenient both for the town and harbour, and what will be found a real addition to both, and attended with the least inconvenience. When a town is cut up, and subdivided, in order to form a convenience for shipping, who amongst us does not see its inconveniences? But when a situation for that accommodation is made choice of which proves a real addition, and leaves the town quite connected, may I not put the question, who amongst us does not see its propriety? And surely that ground which I have chosen for my basin in the view now given does not want its claim to your Lordship's attention. The place commonly known by the name of the Timber Bush, lying near the entrance of the barbour, and upon which few houses stand, being mostly an open area, and so contiguous to the sands, from which additional ground can be taken to complete the basin, led me to the choice I have made; and also apprehending, that from the lowness of its situation, and an easy disposal of the earth to be dug, tended to confirm me in the opinion that it would be found to be of less expense than in most situations it could be placed. This I am certain will be the case, notwithstanding the sea-dyke that must be there built. This situation will be found, upon minute investigation, to be attended with advantages that no other proposed place can claim; its readiness of access being so contiguous to the entrance of the harbour makes it surely the most commodious.

That there will be less expense in digging is evident from the ground being so low, as the water, if not kept out by walls, would overflow it. It is little or no encroachment on the town;—what it occupies is mostly open area, and great part of the basin gained from the sea. A quay can be formed all around it, on which houses can be built, without pulling down a single house of value to make way for it; and these houses, especially those next the Frith, will be the most pleasant and agreeable in the whole town, the feus for which will go a considerable way to indemnify for the raising of a sea-dyke, the expense of which will be found by no means so formidable as some have alleged, and as Mr. Whitworth, from misinformation, has judged. The till or clay in this low ground runs all upon a level; and therefore, when the surface is equal, it is everywhere to be found at an equal depth; of consequence, the higher up in the land the basin is carried, the more digging, as it must be dug to the depth of the barbour, wherever placed. I am by no means apprehensive of much difficulty by having sand to dig, providing I can keep the water from making it run; in doing which, I know, whatever information most of those who wrote stand in need of, Mr. Whitworth needs none; and by the assistance of a steam-engine, which I would propose to erect in the very centre of the basin, or where it could most readily command the water, I pledge myself, in the place I point out, to make a

APPENDIX C.

LEITH.

No. 4.

Shirreff, on enlarging and improving the Harbour and Town.

wet basin at less expense than where Mr. Ker has laid down his, which is attended with the pulling down so much property, and at little more expense than the spot Mr. Whitworth has made choice of. As for the basin pointed out by Mr. Scougal, in the run of the river, I hold it not practicable, without making a separate entry by which the river may be discharged, which, as it appears to me, would prove the ruin of the harbour altogether. This wet basin, which I am for entering about the old mill at the foot of the quay, I would propose to run no further along the sea shore than the road leading down to the sands that goes by the front of the Assembly-Hall; which road will in that case fall to be the upper end of the basin, and serve as a discharging quay to it, and will thereby preserve a very useful road. A basin of this extent, I think, will be found sufficiently large for all the ships that may enter, as only tender or very large ones would be run in, and that only when they have a cargo on their bottom. The additional room in the present harbour I have proposed, if accomplished, supersedes the necessity of having the basin so very large as I at first pointed out; and, by circumscribing it in this manner, removes the great objection of occupying too much ground along the sea-shore, which no doubt is at present very usefully employed. In forming the inclosure next the sea, I mean that two walls should be built, one next the basin of about 5 or 6 feet thick, another next the sea of about 10 feet; each at 100 feet distance, with interjoining walls 50 feet asunder, which will prove good foundations for warehouses, and dwelling-houses above; and betwixt these walls the clay and mud from the basin is to be lodged, which will be found an easy way of getting clear of a good part of it. This breadth of quay of 100 feet will allow 40 feet before the houses next the basin for a discharging quay, 40 feet to be occupied by the houses and warehouses, and 20 feet behind next the sea, which will form a small quay, and be found extremely useful in the transporting of timber, &c., from the harbour. This basin will communicate easily with the present harbour, by an entry, over which a drawbridge will be thrown; and its quays will join with your present quay and pier: it is proposed to be circular; in which form it must be built to give sufficient strength, and in that situation will have a claim to elegance nothing short of Mr. Ker's basin, on which account I would even give it the preference. And indeed the ground made choice of by Mr. Ker does not admit of it, without increasing the principal objections to it—pulling down much more of the town, and occupying still more valuable property. I am at a loss to find out how a sheet of water of the same extent shall be found to be more elegant in one part of the town than another, unless it may be from the form into which it may be thrown; and I cannot therefore account for some saying Mr. Ker's plan is attended with more elegance than the basin I point out; to which I have only to add, that if the plan of a basin on this low ground is gone into, and tradesmen applied to for estimates, notwithstanding the sea-dyke, it will be found the cheapest. The late large inclosure made to the eastward is a full proof. The tradesman who executed it assures me a sea-dyke will not cost much above two-thirds of the sum named by many, and would be very happy to contract for it in such a way as fully to make good my assertion.

Having now pointed out where I would have a basin, and circumscribed its extent, so as to make it no larger than in all probability may be found necessary, by which the greatest part of the ground it occupies is already in the town's hand, I shall now take a view of the objections against it that have been advanced; and—

1. A shoal of objections mentioned in Mr. Whitworth's remarks from p. 17 to 19, advanced against a basin in a similar situation, by a plan that has been produced by a Mr. Gordon, of which I never had heard till Mr. Whitworth brought it forward in his general remarks, and under whose wings he has placed me, but says attended with more difficulty, as I take a deeper hold of the sea.
2. Can there be any comparison between the basins of Messrs. Whitworth, Shirreff, and Ker, and the one I have proposed? a question put by Mr. Scougal in his last publication, p. 6.

Each of which in their order.

When Mr. Whitworth, in page 17, is about to set out with his objections, he is pleased to say that the situation pointed out "is most certainly desirable in respect of conveniency, and that it did not escape his notice; and had not there been an objection to it, that seemed not to be known to Mr. Gordon, it would have been fixed upon by him as the most eligible situation for a wet dock;" which is so far favourable: and to confirm your Lordship and Mr. Whitworth that his opinion was just respecting its situation, have to observe that I learn it has long been thought so by many, and has long ago been pointed out as such, upon former proposals of having a wet dock formed to aid our harbour; and had Mr. Whitworth not rested himself upon uncertain information from others, but allowed his good judgment in this business to have acted freely, and had properly attended to the erection of the south pier, and the wall lately built to the eastward, which is a positive proof the work can be accomplished, he certainly would have fixed upon a place that at first struck him as the most convenient situation, and not have shaped his course where at certain seasons of the year no ship can follow him; and thereby not laid his proposed basin open to such objections, as, when duly considered, shows they are not to be removed but by his returning to his first thought. The observation of Mr. Whitworth resting on uncertain information is founded upon his saying "That he is informed a projection recently made, of only about 20 or 30 feet, has caused sand-hills to accumulate near the end of the pier; and that the embankment would cause a necessity of filling up the timber pier, which now takes off the swell and fury of the sea in stormy weather, when the wind blows from the north and north-west, and prevents it going up the harbour, to incommode the shipping." In the manner that Mr. Whitworth sums up his opinion as to these two objections, it shows he judges them to be of little or no consequence; as he says for the first, "He will not pretend to say what force it should have; and as for the other, it should have no weight, as the water's own gravity will soon quiet its fury." As they have little influence with Mr. Whitworth, they have similar weight with me, and should not have been noticed, had it not been for the sake of this observation, that Mr. Whitworth appears rather inclined to gather together the smallest hints against his first-thought favourite spot that may have influence with those who have not opportunity to make a due investigation, but yet may have a powerful negative voice of saying, It shall not be here. And as this argument of the embankment does not originate with Mr. Whitworth, but takes its rise from those among ourselves who may endeavour to make it have some influence, it may be worth while to examine the nature of the sand-banks formed at so considerable a distance, to know if the embankment could possibly extend its influence so far out. The embankment which he says he is informed has occasioned sand-hills near the end of the pier, is Mr. Learmonth's inclosure of about 20 or 30 feet of projection. Now,

APPENDIX C.

LEITH.

No.4

Shirreff, on enlarging and improving the Harbour and Town.

were these sand-hills thrown out by any projection from the south side, they would constantly be found to be largest from the side of the river from whence they proceeded; which is by no means the case, for the banks of sand are found equally at the entrance of the harbour on both sides the bed of the river, and can be formed by no other influence but that of the sea forcing the sand along with it from the rocks, over which, in high winds, when much agitated, it rolls with great force, and raises the sand, which is frequently counteracted by the run from the harbour, and thereby thrown up in banks on both sides, which forms the channel into the harbour: hence we see them winding and shifting, after considerable speats, as the run from the river has taken its direction. The influence of the sea that comes up our Frith in a high easterly wind is extremely uncertain; for frequently one tide will carry along with it, and lodge upon our sands, considerable banks, and another will take them away: so that, to ascribe any sand-hills to such an effect as a wall placed on the land at such a distance, is equally as uncertain as improbable; and upon conversing with those who have long ploughed the watery element, and have had frequent opportunities of examing all the ports in Europe, they have given it as their opinion that an embankment, where necessary to form the basin, can have no bad effect on our present harbour, nor its entrance, and that this situation is the best place for a wet basin that can be pointed out. This opinion, which quite corresponds with my own, I find supported by many belonging to the town; and a very decided one was within these few days given in my hearing by an experienced seaman, and who has had an opportunity of examining harbours in almost every country. His opinion I notice, as he is one from another quarter, unbiassed or attached by any particular interest; but who, from a frequent sailing to and from the harbour, must be allowed to know as well as any other in his way what must answer.

The elliptic form of the proposed basin, which will only reach half-way down the open pier, and thereby leaves it open for the reception of the swell of the westerly sea, entirely removes the other objection, although it had been of force. The next objection made by Mr. Whitworth deserves a little more attention than those already discussed, as it appears so very formidable in the eyes of Mr. Scougal, that he says, page 7 of his last publication, "That it appears to be unsurmountable, the interruption that must be given to the harbour, by ships going in and coming out of it." If I am allowed to use the manner of argument which Mr. Whitworth adopts, I would urge with full force, that it is *curious to observe* that this small interruption has so much stress laid upon it, when both these gentlemen think little of placing their wet docks above the present harbour, which must thereby be greatly interrupted by the vessels that shall attempt to reach them, and thereby occasion such disturbance, and frequent damage, that every ship in their way will be under constant hazard, and those on board in perpetual alarm; although I do believe that the damage occasioned by these passing ships will be very little, and the alarm given but seldom, as few will incline to warp so high up the river, if they can find but an indifferent berth below; and when the harbour is throng, which I hope will frequently be the case, they may not be able to make up in several tides; and if a fresh in the harbour, will be found impossible. These inconveniences strike strong in my mind against every plan that proposes either basins or discharging quays above bridge. This does not apply with such force against light ships going up for repair, as it does against those which have a weighty cargo on their bottom, and have a deep hold of the water. But where was this objection of interruption as to Mr. Scougal, when be thought of placing a wet dock at the upper end of the Ballast Quay, with its entrance pointing quite across the harbour, and that in its most narrow place? The entrance to the basin opposite to the Sand-port, is a wide extended place where ships can with the greatest ease be managed so as to give little or no interruption; and by the entrance being made to point a little downwards, it will be taken as readily as any ship can well be laid in her berth anywhere else. Its readiness of access is its great advantage; for, the same tide that a ship takes the harbour, she is docked, and may have her cargo half discharged before she would reach Mr. Whitworth's basin above the mills, or even on many occasions Mr. Scougal's discharging quays above bridge. But I am led to think, however unsurmountable the above objection, when applied to the entrance of the basin, is with Mr. Scougal, that it is not quite so formidable with Mr. Whitworth, who urges it; for he says in his next paragraph, where he states his last and greatest objection. "To these objections and inconveniencies I must add one other, which, in my mind, far outweighs them all together, and that is, the extreme difficulty in the execution; but which (he goes on to say) I will not say is impracticable." And as I never understood a thing that is not impracticable to be unsurmountable, I therefore judge that Mr. Whitworth's argument of interruption is carried further than be intended, or has place with himself. But let us now examine this last and weightiest argument, bordering as near to impracticability as anything Mr. Whitworth can conceive. Had the declaration come from some of the other gentlemen, it should not have surprised me; but I did not expect that one of Mr. Whitworth's experience, who certainly knows the use of what he calls grove-sheet piling, and the power of a steam-engine, which can be erected for three or four hundred pounds at most, quite sufficient to command all the under-water, should have thought making a basin in this situation so extremely formidable. A steam-engine erected, which can go night and day, will save ten times the expense that labourers employed to do the same work would cost, and make the prosecution of the work quite safe and certain. It is not from the flowing tide the hazard is; for that can be kept back by a temporary erection sufficiently fortified by the fine command of large sea-stones that lie at the east end of the sands, and will be of use when the sea-wall is built, to form a proper buttress. It is the under-water coming from the bottom of the basin as it is dug, that will occasion the sand to run before the till or clay is reached, and will be found the most troublesome, but which, with the assistance of an engine, can be thrown out into the harbour, over the entrance of the basin, which must be first formed. From the nature of the ground, and the lowness of its situation, a wet basin must be formed here at less expense than anywhere else that can be found equally convenient for the harbour. I might here put the question to Mr. Whitworth respecting the impracticability of this work, which I have put to Mr. Scougal respecting the interruption of its entrance. Where was this objection with Mr. Whitworth, when he thought of planning a vast basin to the westward, taking a much deeper hold of the sea, and exposed to more powerful winds? But I am convinced little more need be said to show the practicability of the work; and tradesmen will readily be found to undertake it upon such terms as will show it not that very formidable thing represented, in the expense of which considerable attention should be paid how it will be reduced by the favourable situation of its quays for houses and warehouses, which a basin so high up as the one proposed cannot claim, even although ships could reach it. Affinity to our dry harbour near that place where ships can be soon and readily laid will always secure a great advantage and value to contiguous property. Mr. Whitworth's observation as to the value of the ground is now of no force;

as that which I propose to occupy, reaching from the harbour to the road leading by the front of the Assembly-Hall, except what is already in the town's hand, has, within these few years, been purchased for about as many hundred pounds as he names thousands; and the whole may be taken off the sea, if thought proper.

Having now noticed, and endeavoured to remove, Mr. Whitworth's objections, Mr. Scougal's question comes now to be considered: and which he states when his mind is full of the capaciousness of his basin, when just about comparing its breadth and its length with the others that have been proposed, and says with full confidence,' "Can there be any comparison between the basins of Messrs. Whitworth, Shirreff, and Ker, and the one I have proposed?"—If I thought myself at liberty to use a little freedom with my good friend, I could put him upon a plan in his way of counting, that would have made his basin as formidable in dimensions as all the three put together, and pledge myself for his having water enough to fill it although no assistance was to be had from the sea, and that is, by bringing the heads of North and South Pier so near one another as gates might be clapped to them, or by placing gates so far down as the head of the Ballast Quay (in case Mr. Scougal should think it necessary keeping the Sand-port open to run vessels in, that would frequently endanger his gates, when favoured with a leading and fresh wind); either of which would form a basin, of which, for its length and breadth, he might sufficiently boast. But I beg my good friend's pardon for thus pointing out an additional plan for the enlargement of his basin, as, upon further consideration, I am inclined to think it is unnecessary; for, if the gates where he places them are sufficiently high and strong, a basin will frequently be formed of at least sufficient breadth to put every other basin in defiance respecting its extent, the bounds of which will scarce be checked by North and South Leith, as the river, in certain seasons, is so swelled by rains that the discharge proposed is by no means sufficient. There is a certain ornament and beauty which will attend every such basin in the course of the river, that others I own will not be able to boast of; that is, such a beautiful cascade will be frequently formed by the overflowing waters, as, however much it might prevent the harbour being crowded with ships, would frequently crowd the town with strangers to behold the noble sight. It may be observed, that rather much has been said against making a basin in the course of the river, when it in a great measure is given up by Mr. Scougal; but I am informed it is not given up by others, who have also laid before your Lordship similar designs. And I am clear of opinion, that if the river is stopped in its course to make a wet basin, what I have pointed out must happen, or another course must be found for it, which would soon prove the ruin of your harbour. It was the course of the river that first formed it; and wherever that course is pointed when in its greatest force, there, it will be found in the end, your harbour must be. In short, the most distant hint of altering the course of the land-floods, or of locking up our present harbour in the run of the river, either in part or in whole, by flood-gates, appears to me so strange, that I am surprised how any person can think of it. The same observations which Mr. Whitworth mentions in his remarks respecting the land-floods occurred to me from the first; I therefore always opposed the idea of flood-gates in the harbour. And when it is also considered the vast confusion these gates would perpetually occasion, I am the more surprised any should still hold by it. If such a thing as a wet dock is made, it must be quite out of the run of the river, and the present harbour must be left open for the accommodation of all those ships that would not make use of it, although they were allowed to enter without a charge of dock-dues, of which number are five-sixths that enter the harbour; and I will venture to say, if not more commodiously placed than above the mills, nor even above the bridge, nine-tenths will be found to reject it. Before I leave the objections made against my basin, I must mention one or two more that I have heard advanced in conversation; the first of which is, "The sea, when agitated with an east wind, will beat down the sea-dyke." In answer to which I have only to observe, that the South Pier running so far out, and in a direction more favourable for the sea making an impression, is a proof that a wall can not only be built where I point out, but in such a way as to be quite sufficient to resist all the sea that will come against it. Private gentlemen accomplishing a work of this nature at the east end of the sands, in a more exposed situation, and lying in the same direction, is another proof of the practicability of this; and as a direct line may be extended from where the sea-dyke is proposed to begin, at the back of the open pier, near fully as far out, the expense should not be thought so very extraordinary in a public work of this kind, the benefit of which is not for a private company, but that of a whole nation. The other strikes equally against all not in the run of the river, "That they will fill up with mud;"—the easy way of clearing which is by forming the basin in such a way as, when filled with water, a sluice can be made to contain as much as thought necessary to scour it; which, being let out at low water, will carry off all the mud that the flowing of the tide may have brought in, and which is an established practice of clearing basins in similar situations.

Having now endeavoured to establish the five first articles that appeared to me necessary in the enlargement and improvement of our harbour and the town of North Leith, it only remains, respecting the improvements, to point out the additional roads and streets necessary to be opened. But before I leave the harbour entirely, there is one observation I would make, that I think might be of use to shelter the Sand-port—That the elbow of the North Pier should be run a little farther into the bed of the river, which it would thereby a little more confine, and give perhaps additional force in clearing the bar; it would at least tend to run away the bank so frequently formed on that side: as also, if a porch was made in the South Pier, where the timber and stone pier joins, this might be of great service in conveying of timber, &c., from the harbour. There are several other small improvements that may be attended to, which it is unnecessary to notice at present: shall therefore now consider the opening of roads necessary for the conveyance of goods both to city and country, which is the last thing to be noticed.

The opening of roads for the improvement of a country, and of streets for the enlargement and improvement of towns, is a work of national benefit; and in doing which your Lordship, and Sir James Hunter Blair, with the Council of which you are at the head, have of late set the most noble example, and must tend to perpetuate the memory of those who have been so extremely active and public-spirited as to begin, carry on, and finish, what could not have been expected to be accomplished in so short a space, and that with such elegance and taste as to render the neighbouring city an ornament to the country, and the admiration of strangers. This same public spirit now points at the enlargement and improvement of the port of the capital; and it is hoped it will not be long before an equal taste for elegance and use will be shown in a place by the improvement of which the nation in general will reap the advantage, and the city in particular. From the increase of trade, our streets are found so much crowded by carts loaded with large and cumbersome

APPENDIX C.

LEITH.

No. 4.
Shirreff, on enlarging and improving the Harbour and Town.

articles, that carriages are frequently interrupted in passing; it therefore becomes necessary that every improvement be made to our present streets, and new ones opened. There has been one very properly pointed out by Mr. Scougal, along the upper part of the town, leading towards the harbour. That which goes along by the Assembly-Hall and the chapel should also be extended in almost a straight line, running along the east side of the churchyard, and be carried through garden-ground belonging to Mr. Pew and others, which will bring it to the foot of the great road leading by the side of Leith-walk up to the city; which road being opened, will make an excellent accommodation for carriages going and coming from the Sands, and from all parts of that quarter of Leith; and will much relieve the Kirkgate, a street so frequently crowded with carts and carriages, that they endanger one another, and much hazard foot-passengers. Other cross-roads joining these two main passages will also be found necessary for ready communication, which may be pointed out afterwards.

Having now finished the first thing proposed, the establishing of the various improvements I had the honour of pointing out to your Lordship immediately after the publication of Mr. Whitworth's plan, I shall now proceed to do the next thing proposed, that of taking a view of the different publications on this subject that seem most to have drawn the attention of the public; and these are, the plans produced by Messrs. Whitworth, Scougal, and Ker. There are other two that have also come to my hand; one signed "Observator," of the 11th January, which is not without its merit, especially when it is considered from what a young hand it is said to come; but as the additional discharging quays it introduces are above bridge, the arguments against Mr. Scougal's plan will equally apply to it. The other is that of a Citizen, dated 11th February, which points out an enlargement of our present harbour, for a full accommodation of shipping below bridge; and as it extends that enlargement so far as to meet my ideas of the main street of North Leith forming a quay to the north side of the harbour, it therefore claims my support so far as it goes. But this Citizen, not looking high enough up the river for further accommodation, makes the plan very imperfect, as he does not point out ground for ship-building to supply even the scanty allowance presently allotted for that purpose, which the enlargement of the harbour deprives us of. There is indeed a noble sea-wall represented behind the North Pier, running to the citadel, betwixt which and the land this gentleman means to supply our ship-builders; but the ground he there points out is not sufficient for the accommodation of Mr. Sime alone. But this improvement is well worth attention, as it gives additional ground around the two dry docks I have recommended, which is necessary for holding of plank and timber; and also is an excellent place to contain the mud or clay that may be dug from the harbour in making the enlargement, or even what may be dug from a basin, if one is made, and will be a valuable acquisition gained from the sea.

There is also a plan that comes from Mr. Cuthbert Clarke, and one from Mr. Gordon, both of which are taken notice of in Mr. Whitworth's remarks; but as none of them have come to my hand, I can say little about them. So that it only remains making a few observations on the three first mentioned, which I shall do in the order they are placed. And, first, for Mr. Whitworth's—a plan, however much it appears to come from the hand of an engineer, yet is the plan of a stranger, and therefore contains errors which might have been expected from one not fully informed of the nature of the river in all seasons of the year, and the accommodation our trade requires; and such, therefore, as ought not to have been treated with such pointed language as some have thought proper to make use of. Mr. Whitworth's plan, whose main, and indeed only object, is that of a wet basin, which I suppose he was informed was the great thing wanted, is, in this view, more capable of being defended respecting its situation, when considered as coming from a stranger viewing our river only in a favourable season, undisturbed by speats or affected by frosts, than those who attacked him are aware of, and is such a situation as most strangers would have made choice of. The lowness of the ground where he places it, the surface of which is so little above the water of the river, points out how easily it may be formed; its contiguousness, how readily it can be filled; and being so effectually removed from the raging sea points out its safety; and, in the view that a New Leith may be formed quite round its banks, and prove an addition to the town, strikes a stranger with a propriety of situation that by no means surprises me, especially when it is considered how low and level the contiguous ground leading to the great road to Edinburgh is, to which cuts might be easily made from Mr. Whitworth's basin, for lighters or small craft to reach quite to the side of it, which is by no means impracticable when it is considered the water in Mr. Whitworth's basin is kept up by a large lock. And this situation for an enlargement of our harbour is free of that objection which strikes against Mr. Scougal's enlargement immediately above bridge, namely, occupying the only ground that can be properly allotted for ship-building; which branch will fully require for its accommodation every inch on both sides of the river. But, however the situation pointed out by Mr. Whitworth is to be supported as coming from a stranger, yet it is attended with such inconveniences, that, although adopted, I am convinced would not be found to answer. The frosts in the winter time, which in this country are frequently long and severe, would effectually render it of little use during that season; and the rain in our wet seasons would occasion such a fresh in the river, that very frequently no ship could be carried up even by the force of capstan or windlass, however powerful they are; and being so far removed from the entrance of the harbour would make such a tedious operation the reaching of it, that few ships would attempt going up if they could possibly find a berth below, which they might reach upon their entrance. And this tediousness of warping ships up the river would be much increased by a cause that I hope shall ever be found lasting; that is, the harbour being thronged with shipping, which, if not enlarged in the manner pointed out, will be found in the summer season as difficult to overcome as the frost and speats in the winter. Which reasons are so very obvious against the situation pointed out by Mr. Whitworth for his basin above the mills, that I judge it unnecessary advancing any more.

As to the basin on the north side of the harbour, behind North Leith Pier. Although it could be accomplished for one half the sum mentioned, it would not be desirable, as it is quite out of the way, and will be found not to answer the trade in the port of Leith, which requires the principal part of its accommodation to be on the south side of the river, to answer an easy conveyance to the capital.

Having now so far stated my objections to Mr. Whitworth's plan, as to show, I hope to the conviction of many, that neither the basin above the mills, nor the other behind North Leith, should be adopted, and in such a way as to convince your Lordship they deserve to be fully thought of before complied with,—I shall pass on to consider a little Mr. Scougal's last publication (his first shall take little notice of, as Mr. Scougal himself judged it to have in its construction so many omissions, or so many errors, that a second was necessary to set all to rights); but which, not being so unexceptionable

APPENDIX C
—
LEITH.

No. 4.
Shirreff, on enlarging and improving the Harbour and Town.

nor complete as I could wish, has occasioned me, together with the attacks that have been publicly given to what I pointed out to your Lordship as a plan of improvements that might be adopted, to take the trouble of a defence. Mr. Scougal's plan of additional discharging quays above bridge lies open to the same arguments as those made use of against Mr. Whitworth; and if there found successful, must also here have influence. If it is said that against Mr. Scougal's discharging quays they have not so much force as against Mr. Whitworth's, on account of not being placed so far up the river, I answer, what Mr. Scougal gains in this way he loses in another, occupying by his discharging quays ground that should ever be left untouched, for the accommodation of ship-building. And surely, if the situation made choice of above bridge is not so liable to be frozen up as a basin filled with river-water, yet the unconquerable difficulty of reaching so far up in the time of speats, and the inconvenience of pushing through a crowded harbour, and thereby making it a mass of confusion, are arguments that may be urged with equal force in the one case as in the other. And how frequent have we seen all the river betwixt the mills and the bridge so frozen up, that, should it take place again in the same degree, which I have no doubt of its doing, notwithstanding all the movement of shipping Mr. Scougal proposes, this would render even the situation immediately above bridge very inconvenient. Several other arguments might be urged against laying out money in forming discharging quays above bridge; such as, ships giving the preference to those further down, on account of the nearness of access to the entrance of the harbour, and thereby procuring a quick despatch by getting soon berthed, when it might be either difficult or even impossible getting up, without making a delay of a day or two, which will frequently be found to be the case, and whose cargo, if timber, must be floated down the harbour, to be carried round to the south or north sands, which would effectually secure a preference to a berth below, and that as far down the harbour as possible. But as these arguments are in general already made use of in supporting the enlargement of the harbour below bridge, I judge it unnecessary here to do more than just notice them, and shall pass from Mr. Scougal's plan, without now touching his hint of giving interruption to the present open harbour, by being in any part thereof made a wet dock, in the way he has thought proper to point out; as argument against that scheme have also already been noticed, sufficient to show what an interruption it would prove; and especially it is unnecessary, as Mr. Scougal seems to give up with it, as he says, "If the gates are found inexpedient or hazardous, they can be removed;" which implies a doubt in his own mind of the expediency of what few seem to doubt either the inconvenience or hazard of.

But before I leave Mr. Scougal's plan altogether, and as I have always found an inclination to give his schemes all the support that a fair and candid judgment would admit of, especially if I thought the object a favourite one, I shall take the liberty of pointing out a situation for a wet basin in our present harbour, which, in my opinion, will be found much more convenient than any that can be placed in the bed of the river; and which I propose as an aid to Mr. Scougal's plan, and therefore have not introduced it as connected with my own, but is a situation, if the one I have pointed out along the sea-shore is rejected, I would rather fall in with than any that have yet been proposed. As I am for every accommodation being given for large and tender ships (which is what makes a wet basin so much to be desired) to be as near the entrance to the harbour as possible, for the reasons already advanced, I would therefore propose that this basin I am now to point out should be made in the enlargement that I have proposed to take place below bridge on the north side of the harbour, to extend from Mr. Drybrugh's dock as far down as the Sand-port; where, on the north side of the Ballast Quay, should be placed the flood-gates of this basin, the south side of which must be a quay extending from the Ballast Quay in a line with the gates of Mr. Drybrugh's dock, and the North Quay to be that of the present main street of North Leith. At the upper end of this basin I would propose also a flood-gate, that ships going up the river to repair may take, and also let in a run of water when the land-floods happen, to clear it of mud. The enlargement of the harbour I have proposed will make room for this basin, and not hurt its present accommodation. It may be said to have almost a separate entrance from the harbour, at least such as will prove no inconvenience,—it will be soon and easily taken,—it leaves our present harbour open for all ships that are not to be run into it,—it is quite out of the hazard of the speats that frequently happen in the river, and which can never affect ships taking it;—in short, it is accompanied with every advantage that a basin in our present harbour can possibly have: and against it there seems only to lie two objections. The first is—"Being on the north side of the harbour, although as nearly situated for the accommodation of the south side as possible, yet may be found inconvenient." The other is—"Although it may be no encroachment on the present harbour, yet may stand in the way of the South Quay being made so broad as could be wished." As for the first, I would propose a drawbridge being placed at the New Quay, as laid down in Mr. Whitworth's plan, with a quay and drawbridge quite across the dock, if thought necessary, to make an easy communication to all sides of it:—this, with the present bridge at the head of the harbour, would tend in a great measure to remove the objection of inconvenience respecting its situation. As for the other, respecting making the South Quay so broad as might be wished, yet additional breadth might be obtained where this quay stands most in need of it; the sweep of the harbour, even in its present state, favours it.

Thus, my Lord, I have pointed out a situation for a basin in our present harbour (if one there must be) that at least deserves your notice; and I hope the gentleman whose plan I wish thereby to aid, will at least thank me for my good intention.

The argument of hazard by speats in the river, urged and made use of against Mr. Scougal's large and capacious basin, of whose dimensions we have already seen he has boasted, has no place with that also large basin pointed out by Mr. Ker. It is free of every unpleasant circumstance of this nature; and forms so agreeable a picture, that it has once and again drawn my attention; and as I have a little taste in that way, it was not without design I put it last in order to be considered, although a publication prior to Mr. Scougal's, that I might find a little relief in its contemplation, after the fatigue of canvassing the plans of others. This is the plan that Mr. Whitworth calls "the most grand design of any that has been exhibited." It is well he has not termed it the most elegant and grand he ever saw, or that the situation of the town and harbour would admit of. This would rather have pointed out a want of real taste in that gentleman, which I have not yet discovered. As I have now entered on the pleasant contemplation of what is picturesque, I purpose to point out, before I leave it, a plan, that I hope shall be allowed, even by Mr. Whitworth, to be nothing short of the grand design, and, from the expense that may attend it, not very much further removed from the possibility of execution. Notwithstanding the favourable appellation given by Mr. Whitworth, Mr. Ker has thought fit to give his remarks an angry reply; and surely I cannot be blamed by Mr. Whitworth if I should

APPENDIX C.

LEITH.

No. 4.
Shirreff, on enlarging and improving the Harbour and Town.

dispute what he has here been pleased to advance, by showing he goes rather too far in giving it so hasty and decided a superiority even in point of elegance, and thereby endeavour to soothe Mr. Ker a little, and reconcile him to remarks that have done him so much justice. And I hope I will not be thought unfriendly by Mr. Ker, endeavouring to reconcile him to one who has not only so well pointed out the hazard of his proposed wide-extended basin in its execution, but also the vast expense that will be found to attend it, which, notwithstanding all the returns proposed by Mr. Ker, will be found to leave a very heavy balance, and thereby occasion heavy lock-dues, which the projector would certainly be exposed to pay, as no doubt his attachment to his own plan would make him run his ship in as oft as she enters the harbour. I have already observed, that I am at a loss to find out how a sheet of water in one place of the town, of the same extent, should be more elegant than another, unless it is by the form into which it is cast; and surely an oblong shape, only straight on one side, is none of those figures that has the highest pretensions to elegance. The plan Mr. Whitworth alludes to in his remarks, of a basin constructed along the sea-shore, although now restricted, was as capacious and large as Mr. Ker's, and, being on all sides of an equal elliptic form, has a much higher claim to elegance: the great advantage of the houses on its quays was also observed to be superior to those on the sides of Mr. Ker's, as they would be open to a view of the Frith, and thereby a most pleasant situation. It has also been shown to be a real addition to both town and harbour, without pulling down almost one house of any considerable value; whereas this plan, at first sight, shows what vast number of houses it pulls down, and what useful property it occupies where many might be built. Had the houses pulled down by this extended basin been the worst and most irregular in the town, the destruction it makes might have been put up with; but it not only pulls down property of value, but cuts up a most agreeable and spacious street, and by its long shape separates one part of the town from another; whereas the basin proposed along the sea is not only a real addition, but leaves the town and present discharging quays quite connected:—for all which reasons I do not give it that preference which some may perhaps be inclined, as a plan to be adopted for real use, whatever merit there may be in its projection, and however pretty a picture it makes as represented to us upon paper. But if elegance, more than use, was to be attended to, however great the expense, what suppose it should be tried if a more grand design could still be formed, attended with this advantage of pulling down a most irregular ill-built part of the town, and having its discharging quays more connected with those we have already, than the one we have now been considering, the elegance of which has been held forth by Mr. Whitworth as its greatest property? Taking it for granted I have your Lordship's liberty, shall for once suppose that part of Leith pulled down lying betwixt the Tolbooth Wynd and St. Andrew's Street, and a spacious open there made, which comprehends a considerable number of irregular ill-built houses, which the town would be well free of; and in this open a large basin, formed of a crescent shape, the extended part of which from the harbour, reaching so far as the main street leading by the church to the city, would make a spacious basin with discharging quays, forming elegant streets, and whose extended wings would join those we have already leading up and down our present harbour, and thereby stand quite connected. But suppose for elegance sake I should still go a little further, and at the head of this crescent make an open, and reach a canal quite across to the Links.

A still greater extension of plans and designs might be pointed out, by looking towards the river; and by clearing its banks of every incumbrance, lakes and canals might there be formed, sufficient to environ the capital itself. But I suppose enough has been already said to secure from Mr. Whitworth the appellation of the grandest design yet proposed, and to show your Lordship and Council, when expense is not to be regarded, that the harbour of Leith is capable of vast improvement; for, even in this last design, there is nothing pointed out but what is within the compass of execution, but, I suppose, equally removed from it as any other plan that may be found, dividing our town, cutting up our streets, and dealing destruction around in such a way as its adoption would be extremely hurtful to many. It is not sufficient argument to say, value is given by jury; for, although the valuation by jury is the best way that possibly can be pointed out, yet such frequently fall short of the value of property to individuals, who may be so situated, respecting the carrying on of their trade, that their loss cannot easily be made up; and therefore the plans that pull down least valuable property, and prove the greatest additional advantage, are surely to be most attended to. I freely allow this argument of economy may be carried too far, and so much regard paid to it as to prevent an useful design being carried into execution, which is to be guarded against. The golden mean is the course I hope your Lordship and Council shall be directed to follow, and thereby neither show an unbecoming extravagance, nor a mean saving. For which purpose, I would again recommend the making application to Mr. Whitworth, or some such professional gentleman, who may now have seen the objections and advantages attending each plan that has been produced, to lay before your Lordship and Council another design, which may be found to give general satisfaction; and to whom I shall leave the calculations of estimates, without here attempting any, as, from want of experience in that way, I am convinced any I could give might be as uncertain, and as little to be depended upon, as some of those which have already been laid before you.

As I have already paid considerable attention to Mr. Whitworth's remarks as they fell in the way to be answered, so far as they pointed out objections to the plan I had the honour of laying before your Lordship, it is therefore unnecessary to take further notice of that publication. Only I find myself inclined here to caution Mr. Whitworth against laying too much stress on his argument of impracticability respecting my sea-dyke, as, if successful, will be of equal force against his basin in North Leith; and as his argument of interruption as to the entrance of my basin can be employed with more advantage against his own and Mr. Scougal's discharging quays placed so far up the river, I would advise it also to be passed from.

The improvement that is now proposed by your Lordship and Council for the harbour of Leith will not only be of benefit to many in the city who are very considerably interested in the exports and imports that take place, but the increase of trade that such accommodation paves the way for will greatly add to the city's revenues. And after guarding your Lordship against an opinion of casting the net for personal praise, in the extension of a trade of which I have had but a small share in comparison with others, may I be allowed to add, the gentlemen of Leith in general are not undeserving of the accommodation, so far as it may suit them; they have, of late years, shown such a spirit for the increase and extension of trade, that merits every encouragement—the aiding of which is a national benefit; and its advancement, however much to be desired, and however much it stands in need of the enlargement of our harbour, and other improvements that have been or may yet be pointed out as necessary, yet it is with reluctance that your Lordship and Council are looked to for the necessary advance, which, although it may be returned to the city by additional revenue, in the mean time is an advance that all

APPENDIX C.

LEITH

No. 4
Shirreff, on enlarging and improving the Harbour and Town.

concerned would wish to shun. As it is a national advantage having the port of the capital made for extensive use, I hope it will not be thought improper my taking notice of the very considerable aid from Government that some towns in England obtained for similar improvements; and it is not doubted that our Most Gracious Sovereign, whose most envenomed enemies could never charge with ingratitude, would lend a favourable ear to an application for aid to improve the principal port of that part of his dominions which gave such assistance in the late unhappy war, especially when coming from that city, which, at a considerable expense, presented His Majesty with a body of men who, during the short time they had to act, showed they were extremely fit for national service. And when our Royal Sovereign shall further remember how our sons, and even aged men, poured into his fleets and armies, to oppose prevailing foes, how is it possible that one, with whom stands connected every virtue which a crowned head ought ever to hold out for imitation, would refuse to listen to so very proper a request, as that of public aid for the improvement of a port which will tend also to make a considerable addition to the national revenue, by the additional duties that an increase of trade is attended with; and which public aid will have the happy effect of preventing any additional burthen, that the whole, if advanced from the city's funds, would necessarily occasion.

As it is but lately I have been prevailed upon to lay my views before your Lordship and Council in this public way, I find it out of my power making another copy of what is now presented, and thereby rectifying any errors that may have crept in. I am therefore shut up to the necessity of rejecting the solicitation of some altogether, or of begging your Lordship's acceptance of what is now offered, as drawn in almost its first state; which last I have ventured upon, hoping that unintended errors will be passed by, and notice only taken of hints that may be of use to the public, whose interest, if in the least thereby promoted, the great design in writing is obtained by,

My Lord,
Your Lordship's and Council's
Most obedient and very humble Servant,
ROBERT SHIRREFF.

To the Right Hon. the Lord Provost,
Magistrates, and Town Council of
the City of Edinburgh.

Explanation of Mr. SHIRREFF'S *Plan of Leith Harbour.*

A.—The enlargement of the harbour on the north side, which may be kept open, or made a wet basin, as laid down in the plan:—this situation most convenient, being near the entrance of the harbour, and quite free from speats in the river.

No. 1. The entrance to the basin on the north side of the ballast quay, which can be taken with ease, and is no interruption to the Harbour.

2. The upper flood-gate of the basin, which ships may take going up the river for repair, and by which the land-floods may be allowed to enter, when necessary for clearing the basin.

3. The quay forming the basin on the south side next the harbour, which serves as a discharging quay to both, and runs in a line with the ballast quay, and south end of the upper dry dock. This dock ought to give way to the improvement to make it complete.

4. The draw-bridge placed at the new quay to make an easy communication with the basin and south quay of the harbour.

B.—The additional breadth proposed for the south quay, the narrowness of which has been found of great inconvenience.

C.—The melioration of North Leith by dry docks, and the extension of the harbour on that side, which makes the main street to become an additional discharging quay, and therefore termed the North Quay.

D.—The building-grounds on both sides of the river above North Leith Bridge.

5. North Leith Bridge to be made a draw-bridge, to allow ships to go up and come down from the building-grounds.

6. The small quays on both sides of the river leading to the building-ground necessary for the accommodation of those who may be giving assistance to the ships that may be going up or coming down the river.

E.—The projected basin on the south side of the river placed so near the entrance of the harbour as makes it to be soon and easily taken, and so situated along the sea-shore as proves but little encroachment on the town, the whole of which may be taken from the ground the sea overflows, if thought proper.

7. The entrance to the basin by a flood-gate at the foot of the present discharging quay of the harbour.

8. East quay of the basin, on which houses may be built, as represented on the plan, and will be found most pleasantly situated.

9. The west side of the basin, on which houses may be also built, as represented in the plan.

10. The upper end of the basin, to which the road by the Assembly-hall joins, and is the road intended to go along through the gardens at the head of the town, till it join the great road leading to the city.

11. A pile proposed to be used in forming a temporary defence against the sea, placed at six or eight feet distance, on which planks are fixed, made water-tight, in which ports must be made to let out the water, if the sea should at any time get in.

F.—Additional roads and streets.

The improvements principally intended by this plan, are an enlargement of the harbour below bridge—the south quay made broader where necessary—the melioration of North Leith—dry docks at the Sand Port—a wet basin taken off the South Sands—and the ground on both sides of the river above bridge laid out for ship-building.

No. 5.

Report by JOHN RENNIE, ESQ., F.R.S., *on Leith Harbour and projected Docks.*

MY LORD AND GENTLEMEN, *London, November* 10, 1799.

AGREEABLE to the minute of your lordship and Council of the 29th of August last, I carefully inspected the Harbour of Leith, and made such soundings, borings, and remarks as appeared necessary for the purpose of not only considering Mr. Whitworth's plans and reports for the enlargement of the Harbour, but also to enable me to form my own opinion thereon, on which account I judged it requisite to have a complete survey taken and a plan made of the town and harbour as it now is; including the coast or shore as far west as Newhaven, and employed Mr. John Ainslie to do it, which plans, sections, soundings, and borings I had the honour of presenting to your lordship and council in October last.

The Harbour of Leith in its present state labours under many disadvantages besides those peculiar to dry or tide harbours. It is much too small, and the water is too shallow for the present extensive and increasing trade. The vessels on the breaking up of ice frequently sustained great damage, and even some in heavy floods which are frequent in this river.

There is great want of room for building and repairing ships, and of consequence most of the vessels which belong to this port are obliged to be built at Hull, or other places distant from Leith, to the great detriment of the merchants, traders, and place in general.

There are only two dry docks, and these have not sufficient room for the business of repairs, and cannot accommodate the trade always when wanted. There are neither convenient cranes for the loading and discharging of vessels, nor proper sheds on the quays for preserving the goods from wet while the revenue officers are ascertaining the duties, or carriages employed in taking them away. Nor do the present narrow quays admit of such conveniences being erected.

The Harbour might certainly be considerably improved by cutting off the awkward projections in North Leith, and making a broad quay on that side. But to do this the present dry docks must be removed, and others made, which, in my opinion, would be attended with more expense than advantage; for this Harbour is too narrow to admit of a considerable number of vessels being properly accommodated, and, therefore, this seems an ineligible plan.

The bed of the river above the Old Bridge might be widened and deepened, and quays might be extended quite to Leith Mills, which would at least double the capacity of the Harbour, and were accommodation wanted for small vessels only, there is no doubt that such an extension would be the cheapest that could be devised. But not only is additional room wanted, but a great depth of water; for the size of the vessels is increasing as well as their numbers.

Experience has shown that goods and merchandise from foreign ports can be carried much cheaper in large than in small vessels. It appears from the very able Report of the Committee of the House of Commons in May, 1796, respecting the trade of London that the average dimensions of vessels trading to foreign ports in 1702 were about 96 tons each. In the year 1751 they had increased to 132 tons, and in 1794 to 196 tons, which is more than double the average in the year 1702, and I believe I may say that the experience of London has been confirmed by almost every port in the kingdom. Therefore additional depth of water seems necessary to the accommodation of the trade of Leith as additional room, for without this the trade must be confined to small vessels, and if so, Leith must be excluded from any extensive foreign commerce.

The Harbour of Leith is formed and kept open by the small river that passes through it to the sea, and like all such harbours is liable to considerable variations in depth according to the wetness or dryness of the season. For when the season is wet, there being a proportionally greater quantity of water in the river, it of course scours the bottom, and vice versa. But there is a point to which the depth can extend and no further (unless an additional quantity of water can be brought into it). This depth depends on the tenacity of the soil, area of the section, and obstructions the water meets by the shipping. In a river whose quantity of water is given, the depth will be nearly inversely as the width. We know what the present depth and width of the channel above the Old Bridge is, and were the latter greatly increased we must not expect that the depth will be preserved. I do not mean to infer from this that no additional depth can be maintained if widened a little, for it is evident, the tenacity of the soil above the Bridge is such that the river, without the assistance of art, can make no great impression on it; but if once cut to a certain section it would preserve it in that state, providing the section was not too great. This being admitted, we must look for accommodation elsewhere than in the present channel of the water of Leith.

Mr. Whitworth proposes to make a wet dock in the low grounds about Leith Mills, communicating with the Harbour by a canal and lock at the Old Bridge. In this situation the ground is low and favourable for such a project, but as vessels must pass through the present Harbour to the lock at the mouth of the canal, they could only enter it with the depth of water that could be there maintained, which could never be so great as at the mouth of the Harbour, and as some time must be consumed in getting from the bar to said entrance, the distance being nearly three-quarters of a mile. Vessels coming in at the point of high water would not only lose some part of the tide, but suffer, also, from the depth being less than on the bar. The narrowness of the Harbour is also an objection, for although a considerable number of vessels will principally frequent the present harbour, those going into the dock must suffer much detention, by passing through that part where they will lay. And when I add to this the deficiency of water in dry seasons for the supply of the docks, and leakage, and for scouring the bar at the time it is most wanted, I do not hesitate to give a decided opinion against a wet dock in the low grounds above Leith Mills, having its entrance through the present Harbour and level above that of the spring tides.

The objections that lie against a dock in this situation (having its entrance through the Harbour) lie equally heavy, nay more so against a dock in the channel of the river above the Old Bridge, for such a dock must be made by a dam across the river. Not only the regular flow of its waters through the Harbour would be obstructed, but the influx of the tide, which also assists in scouring the bar, lessened, and thereby the depth of the entrance must be greatly diminished, while at most the greatest advantage that would be gained, would be accommodation for small light vessels, which would be liable to injury from ice, floods, &c., &c.; and the berths for large vessels must be confined to the lower part of the Harbour; where there is neither sufficient cranes for loading or discharging their cargoes, nor sufficient room on the present quay for their erection, and room cannot be obtained unless it is extended a considerable way into the river, or the houses in front of the shore removed backward, either of which would be attended with more expense than utility.

APPENDIX C.

LEITH.

No. 5.
Rennie, on the projected Docks.

Were the dam to be placed much lower than the Old Bridge, *i. e.*, were the present Harbour converted into a wet dock, the expense would be greater, and if the course of the river were to be turned through the citadel, the almost immediate destruction of the port would follow.

For these reasons it appears to me that the improvement on the present Harbour should be confined to the making of good quay walls, cutting off projecting and inconvenient places, advancing them forward, where the regular slope required, digging the bed of the river and harbour to an uniform depth, which the toughness of the till prevents the river from doing, and scouring away the mud by loosening it in floods, and in general, assisting the means which nature has afforded of putting and keeping in it as good a state of repair as it will admit of. But further than this ought not to be done; for a dry harbour, where vessels must take the ground every tide, is unfit for those of a large and slender construction, as they are unable to bear the weight of their cargoes when laying aground. When I say this, however, I wish it to be understood that I am speaking of the Harbour for loading and discharging only, for the upper part of it, *i. e.* between the Old Bridge and Leith Mills, may be applied to most valuable purposes, namely, for building of ships, and laying up of light vessels and bulks, for which purpose the channel should be widened a little and deepened, and building slips should be constructed on each side of it, and let to different ship builders, and I have no doubt the channel might be kept of sufficient dimensions for this purpose. There is now ten feet water at a good spring tide, nearly as high as Leith Mills, and about 12 to 13 feet at the Old Bridge, and 18 inches or 2 feet more might be made and preserved, but this will depend in a certain degree on the depth to be made on the bar, about which I shall afterwards say something.

The Harbour of Leith has in common with all river harbours its bar, which appears by Mr. Ainslie's plan to be about 200 yards distant from the point of the East Pier, and which varies in distance and depth according to the quantities of water sent down by the river, the direction and extent of the winds, and heights of the tide. The bar is formed at the place where the waters of the river and tide become equal in force to each other, and create a stagnation during which they deposit the silt they contain, and form a sand-bank. This bank is also varied and enlarged by the north and north-east winds, the former meeting the river and returning tide directly in the face, and the latter bringing sand from the eastward through the opening between the Beacon rocks and the Black rocks.

Had this latter chain been continued, the bar or entrance would have been more sheltered, and of course it would have suffered less from that quarter. Nothing, therefore, very great in the way of deepening can be done, unless by sheltering the channel, preserving its direction straight and bringing down more back and scouring water in the absence of the tide.

The best means of effecting this would be to extend the east pier to seaward, but this would be attended with very great expense. The idea that has been suggested of narrowing the mouth would I apprehend be attended with little benefit; for although it would certainly deepen the channel where the contraction is made, and perhaps a short way up the harbour, yet, so soon as it got beyond the mouth it would be obstructed by the sea as it now is, and, although by continuing the body of back-water undivided to some further distance, yet it would only drive the bar a little further to seaward without materially increasing its depth.

The fact is, the tide ebbs too far beyond the point of the pier, and it is useless to deepen the mouth of the harbour while between it and the sea is a shallow bar. The mouth itself is nearly sufficiently deep already as appears by the soundings on the plan which shows nearly 3 feet more depth than on the bar. I am therefore of opinion whatever money is expended in improving the entrance to the harbour, should be expended in extending the south pier, or in something that will lead to the same effect.

What occurs to me as the least expensive mode is to build 3 or 4 strong jetties or buttresses in the sand between the north point of the east pier and the Beacon rocks, to prevent the channel of the river from meandering to the eastward, and thereby make it exert in the proper direction its force on the bar, which with the assistance of the water from a wet dock (as afterwards proposed) to be employed at low water, would when the sand is properly loosened as it must be by art, scour away the sand, and give at least 2 feet of additional depth which in a good spring tide would make the whole 18 feet. Much beyond this we need not look for to the present entrance.

Having now given my opinion with respect to the present harbour, with the impropriety of constructing wet docks in the channel of the river, or above Leith Mills having their entrance through the harbour, I will next consider the different situations on which wet docks may be formed, having their entrance as near to the mouth of the harbour as possible, both on account of ships being able to enter them with as great a depth of water as they can pass the bar, and on account of their being applied as reservoirs to assist in scouring it down, and keeping a greater depth of water therein. In viewing the sites of the towns of south and north Leith, I was particularly struck with the former by the timber brought to the glasshouses, and therefore I examined the ground with great care and attention, both within the sea mark as far as the starting and distance posts, and also within the timber bush, and along by the naval yard to the glass-houses. In this examination I was much disappointed by finding that the till or clay within the sea-mark lay generally at the depth of from 14 to 15 feet under the sand. That is from 27 to 29 feet under the top of the index on the west pier, which shows the depth of water on the bar, and where the top is marked 21 feet 9 inches, except just by the glass-houses, where it is only 24 feet. In one place of the timber bush No. 8 on the plan, it lies 24 feet, but nearer to St. Bernard Street, and about the whale oil house, at Nos. 9, 10 and 11 on the plan, it was only from 13 feet 10 inches to 15 feet 10 inches, but at No. 12 by the naval yard at 26 feet 9 inches, no clay was found, and at No. 13 in the Links, and at Scott and Kid's timber-yard, at 20 feet no clay was found. In the first bore No. 8 in the timber bush at 17 feet a bed of clay was found which was only 2½ feet thick. From this to the lower bed was a running sand, into which bed we bored 3½ feet, when the bore twisted, and would go no further.

At Nos. 9, 10 and 11 we bored 4 feet 2 inches, 2 feet 9 inches, and 5 feet 10 inches into the clay, but did not get through it. In fact it was so stiff that the boring rod though made of iron 1½ inch square would not stand the twist. I was therefore unable to ascertain whether this bed might not have ended at the same depth as that in No. 8, which perhaps is not of much consequence in the present state of the question. From all these we may conclude, that an irregular lump or projecting point of clay lies in this spot, but that the general bed between the glass-house street and the sea lies at least 24 feet under the top of the index at the top of the west pier. This shows the judicious choice of ground made by the late ingenious Mr. Smeaton in the year 1752, for making an entrance to a dock (which he proposed to be where the assembly-rooms, and buildings south and east of it now stand) through the very clay now described. But what was judicious in his time has been rendered much otherwise by the many valuable houses and property that has of late years been erected there.

APPENDIX C.

LEITH.

No. 5.
Rennie, on the projected Docks.

Taking the value of these into consideration, I am of opinion if any dock be made in south Leith it should be partly taken from the sea or sands, and partly from the ground of the timber bush, and wharfs along towards the glass-houses, so that the most of the valuable houses on the north of St. Bernard Street may be preserved, for I expect it will be less expense to build the sea wall on the sands than to purchase that property.

In the plan No. 1 is represented the dyke proposed. The sea wall is 44 yards from the quay wall to allow sufficient room for quays and warehouses, and to deposit part of the stuff which comes out of the docks. This wall must be founded in the clay, the expense of which will be very great, for it lays too low to drain of itself at low water, except in the case of a very extraordinary spring tide, and perhaps not even then. The foundations must, therefore, be laid in cofferdams, and the water pumped out by a steam-engine.

The dock covers nearly 7 acres, and has its entrance from the harbour by a sea lock near the old windmill. It may be either in one large, or two small docks. If the latter, one half with the entrance lock may be made now, and the other half as the trade requires. But this will somewhat diminish the capacity and increase the ultimate expense about 3000*l*. If the whole be made without a division the expense will amount to 66,006*l*. 9*s*. as per estimate No. 1. If the half, only 45,000*l*. as per estimate No. 2, exclusive of the purchase of property. Should afterwards the trade increase even beyond this, another dock may be made south of the glasshouses near the place proposed by Mr. Seaton, of nearly 3 acres, which will cost as per statement No. 3, 17,018*l*. 3*s*., exclusive of the purchase of property. After which if still more be wanted, it may extend into the Links, where docks of any extent may be formed that the growing trade of Leith can ever require, and where there is ample room for warehouses, and dwellings for merchants and others connected with it.

The shape I have given to the docks is a rectangular parallellogram having its width one hundred yards and length as great as the space between the shore and glasshouses will allow, which is 334 yards. The reason why I have chosen this figure is, because it gives more wharf room in proportion than any other form does, and providing the width is sufficient for three tier of vessels to lie on each side (which is as many as can load and discharge at one wharf) and room for others to work back and fore in the middle, it is all that can be wanted. A vessel of 200 tons' burden is generally about 86 feet long by 24 feet wide, and as some room must be allowed for her bowsprit, anchors, &c., she ought to have a space of 100 feet long by 30 feet wide. Three such tiers will require from 28 to 30 yards on each side, which will allow a free space in the middle of from 40 to 44 yards, which is little enough for vessels shifting, turning, and going in and out of dock.

Such a dock as this would therefore afford ample convenience for 64 ships of 200 tons, each, for loading and discharging at once, and for others going into or out of the dock, preparing for herths, &c. &c., and if they were of less burden a proportionally greater number would be accommodated, or if part of the vessels were to be laid up for the winter, such as Greenland-men, or east country ships, which will frequently be the case at Leith, they may be moored with their bows to the quay, and in that case more would be accommodated, but the space in the centre would be somewhat diminished, particularly if the ships were large, which is generally the case with these kind of vessels. Still however, with ordinary management there will be room left for shifting, turning, &c. &c. Taking then those that lay along the quay, those that are laid up, and those that are shifting, this dock would conveniently hold from 80 to 90 sail of vessels above 200 tons, or about 130 to 140 of about 100 tons. But as the dock will have vessels of various sizes in it at the same time, we may fairly conclude, that it will conveniently accommodate 110 or 120 at once, and as they will take different berths in the dock according to their cargoes, and convenience of their owners the dock should be of one depth of water throughout, which depth I propose should be 18 feet, as I expect so much can be obtained on the bar at a good spring tide.

The great width I propose (100 feet) for the quays is to give room for sheds, say of 30 feet wide along the side of the dock under which the cranes may work, and when goods are obliged to remain on the quay, either for the purpose of ascertaining the duty, weighing, or until carriages can be got to take them away, they may there lie in safety and free from damage by wet or otherwise. The 70 feet between them and the warehouses will be sufficient for carriages to pass and repass without interruption, and for a good foot-path along the front of the warehouses. Perhaps 60 feet would be enough, which would leave room for an area between the warehouses and the sea.

Many are the advantages arising from the docks before described, being situated in the lands and ground of South Leith, yet the heavy expense attending the situation led me to consider of the propriety of constructing a dock or docks in North Leith, which, although not so convenient for the merchants, who principally reside in South Leith, yet, being constructed at much less expense, and possessing some advantages which they do not, may, in a great measure, counterbalance the distance: and, as the beach or shore of South Leith is at present most usefully employed for the purpose of landing and stowing of fir timber, deals, and planks, which the docks would deprive them of, the forming of docks in North Leith may not be so objectionable as appears at first sight, especially if a good drawbridge be constructed across the harbour at the end of St. Bernard Street.

Besides, as the trade of Leith is daily increasing, and merchants resorting thither for the purpose of establishing new trades and extending its commerce, their dwellings and warehouses can be built on North Leith and grounds westward thereof, as well as in South Leith and Links, and thereby promote the general interest of the city of Edinburgh and port as much as the other. On this account I was equally particular in my examination of the latter as the former, and this proved that the ground was much more fit for the purpose. For except a short space about 30 or 40 yards north of the west pier where the clay lies 10 feet under the sand, *i. e.* 29 feet under the index, it was generally found about four feet under the sand, or 16 feet under the index; and from a hole which was dug in front of the citadel near to the sea shore, I had an opportunity of seeing that the clay lay within three feet of the surface. I was also informed that a well had been dug some time ago near Mr. Hill the boat-builder's yard, 37 feet deep without getting through the clay. From all these facts it is evident that a dock or docks may easily be made in any convenient situation in the sands of North Leith, or in the citadel.

The plan proposed by Mr. Whitworth for a wet dock on the sands of North Leith by enclosing a piece of ground of about 13 statute acres and a half from the sea, by means of a curved wall from the north point of the west pier to the west end of the citadel, seems to me injudicious, for, although the area of the water is very large, yet there are only about 960 yards of quay room for vessels to lay along, of which 366 only is in front of North Leith, where convenient quays could have been formed, and warehouses built, for the outer wall is not above 20 feet wide, which cannot admit of warehouses; nor is it sufficiently wide for the common purpose of loading and discharging vessels. Why this nar-

APPENDIX C.

LEITH.

No. 5.
Rennie, on the projected Docks.

row quay was recommended I am at a loss to discover, because sufficient earth will come out of the dock to fill a much larger space, and it can be laid between the sea and quay wall at a less expense than taken up in barges and carried to the outside of the pier. But should the expense of laying it within side of the sea wall be even greater, yet the ground gained for quays and warehouses would far overbalance the difference in expense. Besides, its form, though well enough calculated to resist the force of the sea, which, in this situation, can never be very great; yet it is a form which will greatly increase the run of the sea into the harbour, which is already too much; and although Mr. Whitworth proposes an extension of the west pier to check this in his observations on the different schemes that were laid before the Lord Provost, Magistrates, and Council in 1786 and 1787, yet he does not seem aware that the form which he has given to this extension would lead the waves much into the heart of the present harbour, and when I add to this, that he only proposes a depth of 12 feet at an ordinary spring tide, I cannot see that such a dock would be of any utility to the trade of Leith proportionate to its expense.

In considering the situation of North Leith with attention, it appears to me that two plans might be formed, either of which would avoid the inconveniences I have stated. The one is to make a wet dock partly in the sands and partly in the citadel, of a rectangular form, 100 yards wide and 500 yards long, covering something more than 10 statute acres with water. The plan of the dock is represented on the plan No. 2. The former to have its entrance from the harbour through the west pier, near the sand port, by a lock, and what is within the sea mark to be made with two parallel walls about 44 yards asunder, the space between being filled with the sand and till which is dug out of the dock. The other part to be wholly within the citadel. This would admit of a quay 100 feet wide, with sheds as described in the dock for South Leith, and room for a row of warehouses next the sea, which would effectually screen the vessels in the docks from the winds, but what is within the citadel will be very expensive, because it will not only be necessary to level the mount, which alone will cost 2675*l*., but the digging afterwards for about 3½ acres will cost 4375*l*., which being added to the purchase of grounds and buildings in said citadel, will on the whole make a very large sum. Its advantages in other respects are considerable, for the sea wall being nearly at right angles to the north-west winds, which is the direction that affects the mouth of the harbour the most, would not tend in any material degree to increase the run of the sea into said mouth. It would afford ample room for dry docks at the west end of the citadel, which might be emptied at low water by pipes being laid underground into the sea, and filled from the docks when ships enter to be repaired. Its head lying near to the river would afford an opportunity of introducing water from them by means of sluices to scour and clear it out at pleasure, and also to get a small supply of water by means of an aqueduct or cut from Leith mills to supply the waste from one spring tide to another, and thereby keep the depth of water in the dock the same; and if a bridge was built across the river opposite Mr. Chalmer's house, and a new road or street opened from thence to the foot of Leith Walk, a short and convenient communication would be opened with the city of Edinburgh; and by a drawbridge across the harbour opposite to St. Bernard Street, another would be opened with the residences and warehouses of the merchants in South Leith. Its entrance from the Harbour is in the best place that could be chosen, namely, adjoining the sand-port, where it is well sheltered and where there is plenty of room for vessels to turn into or go out of the docks, and its head being so near the place which I propose to be applied to the purposes of ship-building, will afford an opportunity for vessels loaded with ship timber to discharge their cargoes into the river.

This dock has 1160 yards of quay, which is sufficient for berthing of 100 sail of vessels of 200 tons each to load and discharge at once, with plenty of room for those going into or coming out of the docks to turn or shift, say, in all, 125 vessels, or about 200 of 100 tons each.

The whole expense of this dock will be about 64,670*l*. 5*s*. 6*d*., exclusive of the purchase of land and drawbridge, but all this expense need not be incurred at present, for a dock of about six acres could be made in the sand as a part, without the purchase of any property, and it could be extended at pleasure. The cost of this, as per estimate No. 4, is 51,848*l*. 13*s*. 6*d*.

Should, at any future period, the largest dock be found insufficient for the trade, it might be further extended by making a cut from its angle above North Leith church-yard into the channel of the river, and vessels could at high water pass into a dock which might be made above Leith mills, in the place proposed by Mr. Whitworth, or, if a new cut was made for the river from the level above Leith mills through the bowling-green, to the sheriff-brae, just above the old bridge, the water of the river might pass through said cut, and its present channel might be converted into a wet dock of nearly as large dimensions as the other, a sketch of which may be seen in the plan No. 4. but not having made any regular survey for this purpose, I do not pledge myself that the sketch will be what I should recommend after a thorough investigation. But in this case the ship-building had probably better be done elsewhere. Perhaps a convenient place could be made west of the junction of the sea wall with the citadel, where I propose to deposit the surface earth dug in forming the dock, and a dry dock could be made at the sand-port, and others at the east end of the projected dock, discharging their waters into the old harbour when the tide is back.

One scheme for a wet dock along the sands of North Leith is represented in plan No. 3, which like the other, contains 10 acres, and is made by a sea-wall parallel to the citadel for about 216 yards in length west from the west pier, and afterwards come to the road leading from Newhaven by 4 kants. The inside or quay is parallel, and about 44 yards distant from it. The quay wall next the citadel is 436 yards long, making a total extent of quay room of 1006 yards, which will conveniently berth 90 vessels of 200 tons each, and allow ample room in the middle for others to shift; and indeed for some light vessels to lay. It will contain nearly the same number of vessels as the other dock, although it has not so much quay-room. The reason *why* I have chosen to make kants instead of a regular curve is, because they break the waves of the sea better, and prevent it from being led *round* as a curve does.

This dock will not in any respect assist in rendering the mouth of the harbour more unequal, because being parallel to the shore, and not extending so far to seaward as the head of the west pier by 43 yards; whatever sea may be brought along it by the north or north-west winds, will be prevented by the said pier from getting into the harbour-mouth, for which purpose I think if this plan be adopted it will be advisable to make a new head to the pier, founded deeper than the present, and sufficiently strong to resist the effects of the sea.

The entrance to this dock will be in the same place as the former, but its direction will be somewhat different. Vessels however will have an equal, if not a better access than the other, and whereas the dock will be equally sheltered from the west winds by the warehouses proposed to be built on the

APPENDIX C

LEITH

No. 5.
Rennie, on the projected Docks.

quays, the communication with South Leith will be had by a drawbridge at St. Bernard Street, and with Edinburgh by a stone bridge near Leith Mills, and a new road to Leith Walk as in the other plan. The expense of this dock is in proportion to the accommodation it affords, is much smaller than the others as appears by estimate No. 5, amounting to 56,608*l.* 12*s.* exclusive of purchases, which unless the citadel be purchased by the city will be comparatively small, but I am persuaded it would be greatly for the benefit of the city to purchase the citadel, as whenever the dock is done it will be of very great value.

This dock like both the others may be formed of smaller dimensions at first, by making a division at K on the plan; but if this be done some extra expense on the whole will be incurred. It also may be supplied with water from Leith Mills for the purpose of keeping the spring-tide height, and like it possesses capability of enlargement, either by a cut across the ditch of the citadel to the river, and then to communicate with another dock, or by being extended along the shore towards Newhaven. But if this latter idea be adopted, it might probably be better to take the plan represented in plan No. 5, and made only a dock of 5 acres at first, and extend it as the trade requires. This first dock will cost about 41,765*l.* 8*s.* If both be made together they will cost about 68,633*l.*, and should even the two be found too little, they can be extended inwards until they reach Newhaven if so much should ever be wanted; and this leads to another subject, which I confess I have not properly considered, nor indeed have I sufficient information to enable me to say anything decisive. I mean forming an entrance to Newhaven. This although not to be done at present, yet at some future period may be an object of great consequence.

In a former part of this report I have given it as my opinion that, unless the east pier be very much extended, no great additional depth of water can be obtained at the entrance of the harbour, which is of so much consequence to the trade of Leith. The expense of extending the pier would be very great, and when so done I do not apprehend more than 3, or at most 4 feet additional depth of water could be got. A question therefore arises, whether it would not be better to look out for another entrance with more depth of water, and where the depth could be maintained at a reasonable expense, than to be at the expense of lengthening the east pier.

In examining the soundings in the general plan, it appears that when there was only 14 feet 2 inches of water on the bar at Leith, there was 19 feet 6 inches within less than 200 yards of the shore at Newhaven, and this place is scarcely 900 yards from the end of the projected dock along the sands of North Leith, and as the ground is favourable, a canal could be made between the dock and this deep water, of sufficient dimensions to carry the largest ships which can ever be wanted at Leith. But if docks be made along the shore as in the plan No. 5, so far as they go the expense of a canal will be saved.

Newhaven is also directly opposite the roadstead, the water deeper very far from the shore, and there is neither bar nor sand-bank to obstruct the entrance. I do not advise the adoption of this entrance at present, but, I think it is an object that merits attention to be looked to at some future period, and perhaps, not very distant.

Something similar to what is here proposed was done about three years since at Ulverston in Lancashire, where vessels of 250 tons' burthen are brought from the sea in deep water, to a basin or dock adjoining the town, by a canal of a mile and a quarter in length. A like work, but of much greater extent, being for vessels of 700 tons' burthen, is now executing at Grimsby in Lincolnshire, and I do not see why a like project should not be done at Leith if the trade requires it. If such a work were done, vessels of a certain draught of water would have the option of entering the docks through the present harbour, or by the one at Newhaven, and those of a larger draught would enter by Newhaven only. This project, therefore, certainly merits a serious attention; for, if an entrance to the docks of 19 or 20 feet depth of water could be had, it would enable the merchants of Leith to use vessels sufficiently large for any trade that could arise, and, therefore, to vie with any port in the kingdom, and should the projected canal to Glasgow take place, and Leith become a coal port, there is no saying to what extent its trade may increase.

Your lordship and the magistrates may probably think this is looking too far, but I trust, when the rapid and extraordinary increase of trade that has taken place at Leith since the year 1780 is considered, and the extent of country which will be opened to it by the canal, it will not appear unreasonable to look even to this extent.

Having now gone through the different ideas that have occurred to me for the construction of wet docks, and the improvement of the harbour, I will now enumerate the local circumstances peculiar to each situation, to assist your lordship and the magistrates to make a selection.

1. The dock in South Leith has the peculiar advantage of laying contiguous to the dwellings and warehouses of the principal merchants in Leith, and of course will not only save some expense in the carriage of goods to their warehouses, but enable them to bestow a little more of their time in inspecting the loading and discharging of their cargoes.

2. It is capable of extension to any degree, and, if carried into the Links, there is room for whatever buildings may be wanted, and in the most convenient situations.

3. Its being on the same side of the river as Edinburgh, and the principal part of Leith, the expense of a drawbridge will be saved, and of course the interruption given by it to the harbour.

4. The whole of North Leith with the river above the old bridge being untouched, it may be applied to the purpose of building, and repairing of ships and boats with all the trade dependant thereon.

Its disadvantages are:—

1. The very great expense attending the construction of a dock extending as the trade requires.

2. The depriving the timber merchants of the advantage which they now enjoy of landing fir-timber on the beach, and stowing it with deals, and planks in the yard where there is ample room, but which, if docks are made, will be occupied for other purposes.

3. The awkwardness of its entrance, vessels being obliged to lay along the stream, or set of the tide when coming in or going out of the dock, to the obstruction of such others as may use the present harbour.

4. The destruction of property that must necessarily give way for the construction of the docks.

5. The want of water to supply the waste of leakage, &c. to which the small stream now coming from below the Calton Hill, I apprehend is inadequate.

6. There being no means of getting water to scour out the mud, except what may be done by using one dock to scour another, which can scarcely be done with the inner dock, as a passage to

carry away the mud could scarcely be used; the sands abreast of it being too deep to keep such a passage open.

1. The dock in the citadel will be constructed in proportion to its capacity, at 24,000*l.* less expensive to a certainty than those in South Leith, and, perhaps more, because the making of such a foundation as that in South Leith is a very uncertain work in point of expense, and requires much time to do.

2. It in no degree interferes with the ground on which the timber, deals, and planks are landed or stowed along the shore of South Leith.

3. The foundation of the sea-wall being easily made, the dock can be made in less time, and therefore the accumulation of interest of money will not be great.

4. The entrance from the harbour is in a much better place. The harbour is wide and well sheltered from the sea. It is out of the set of the tide, or run of the stream, and in no way obstructs the vessels going into or out of the dry harbour

5. It affords a convenient opportunity of applying the water of the river to scour it, and of being supplied with water to keep its surface level with the spring-tide, and as less silt will enter, of course, it will require to be seldomer scoured.

6. It affords a convenient opportunity of getting an entrance from Newhaven in deeper water by means of a canal.

Lastly. It may perhaps be extended at less expense than the other as shown on the plan No. 4. But to this point I cannot absolutely speak at present, having taken no regular survey of the ground for that purpose.

1. Its disadvantages are its distance from the dwellings and warehouses of the merchants.

2. The expense of a drawbridge across the harbour, and interruptions it will give to the trade. The former, however, will be more than repaid by the saving of interest of money while the works are in hand.

3. Its leaving less room for the building and repairing ships, with the trades connected with them.

4. Its being wholly on the north side of the river, and possessing less capability of extension (unless along the shore), but it is apprehended is as great as can ever be wanted. The dock on the lands as per plan No. 3, will not cost above ⅘ths of the expense of that in South Leith for the same capacity, nor so much by at least 18,000*l.* as that in the citadel, allowing for the purchase of property. Its foundations being shallower will be made in less time than the dock in South Leith, and in as little time as that in the citadel, although there is a greater extent of the sea-wall.

It in no degree interferes with the landing and stowing fir timber, deals and planks, which is now done on the beach and ground of South Leith.

Its entrance being near the same as that in the Citadel, it will be equally well sheltered, &c., and convenient, nay, more so, for the change of direction is in its favour.

It affords an opportunity of applying the water in the river to scour it, and keep it on a level with the high water of a spring-tide, but not so conveniently as the other.

It affords a better, at least a cheaper, opportunity of having an entrance from Newhaven than in the Citadel, for the dock in South Leith affords none.

Its capabilities of extension are the same as the dock in the citadel, but not so great as those in South Leith.

It destroys little or no property, being almost wholly taken out of the sea, and being wholly within the north point of the west pier; it has little or no tendency to increase the run of the sea into the mouth of the harbour.

The disadvantages are, The distance from the dwellings and warehouses of the merchants of South Leith.

The expense of a drawbridge across the harbour, and the interruption it will give the trade, but the former will be more than repaid by the saving in interest of money while the works are in hand.

The leaving of less room for the building and repairing of ships, with the trade connected therewith.

Its being wholly on the north side of the river, and possessing less capability of extension except along the shore, which it is apprehended is quite sufficient, having less room for berthing of ships in proportion to its capacity.

Lastly. The dwelling houses of the merchants must be wholly on the south side of the dock, and its extension, which is not the case with the extension of the docks in South Leith. The difference between this dock and those represented in No. 5, lays principally in the convenience of extension to Newhaven, and having more quay room in proportion to its capacity. I need therefore say nothing further than that it will (although more expensive on the whole) be perhaps, under all circumstances, more proper to adopt than the other, as a dock of 5 acres can be constructed for a sum that does not much exceed that which the city by the late Act of Parliament is enabled to raise.

These being the leading reasons that have occurred to me for and against the different situations I have enumerated, your lordship and the magistrates will naturally ask which, in my opinion, is the best? To this I answer, that the material arguments in favour of a dock in South Leith are, the vicinity of its situation to the dwellings and warehouses of the principal merchants and traders in Leith, and its great capability of extension. But whether these reasons are sufficient to predominate against the very great difference of expense is a question your lordship, the magistrates, and council are better able to determine than I.

So far as ease of construction, convenience of entering from the present harbour, and having another in deeper water at Newhaven is concerned, I have no hesitation as an Engineer, in giving my opinion in favour of North Leith, and when it is considered that the difference of distance from Edinburgh between a dock in North Leith and one in South Leith (when a bridge is built near Leith Mills) will be scarcely anything, and the ready communications the merchants will have by the drawbridge at the end of St. Bernard Street, perhaps your lordship and the magistrates will determine in favour of North Leith. I say North Leith generally, for I confess the great saving of expense in favour of a dock along the sands, and the convenience of making an entrance from Newhaven, more than balances the advantages of that through the citadel.

It is now only left for me to account for the very great difference between my estimates and that of Mr. Whitworth's along the sands of North Leith, where the situation is nearly the same.

The first reason is that Mr. Whitworth proposes only to have 12 feet depth of water at an ordinary

APPENDIX C.

LEITH

No. 5.

Rennie, on the projected Docks.

spring-tide, and I propose 18 feet at a good spring tide. The quantity of masonry and digging in the docks and walls, as well as the expense of freeing the work of water while it is in hand, must be proportionally greater in mine.

2. That the prices allowed by Mr. Whitworth are generally speaking little more than half mine. That walls composed of common rubble stone, within a thin case of ashlar in front, may be built at the prices he has stated, I do not mean to deny. But that permanent buildings, such as ought to be done in this situation, can be executed at his prices is impracticable; they would not even purchase the stone; I say this with confidence, for at the Crinan Canal, where work of the same kind is now in hand, and where the bulk of the stone is got out of the canal, and what is brought from a distance is laid down at 4½*d.* per cubic foot, the buildings cost 15*l.* per rood, at which prices the contractors scarcely get a living profit. How then is it possible in a place (where every material must be brought either by a land carriage of three or four miles, or by a sea carriage of at least seven miles) that work should be done for the same price as that on the Crinan Canal? It cannot be. No workman will undertake to build walls of large materials, bedded throughout, for less than I have stated, and to build it otherwise would not answer the purpose.

I might here have given you an analysis of the prices at which a rood of 24 cubic yards of such masonry can be built, but as Mr. William Sibbald, the superintendent of the town works, visited most of the quarries with me, and others that I did not see, to his calculations of the prices of a rood of such masonry, I beg to refer; and also to signify to your lordship the satisfaction I have felt by the punctuality and accuracy with which he has executed everything intrusted to his care.

The timber and iron-work in the foundation of the lock and gates, and the pumping of water, are articles in which I greatly differ from Mr. Whitworth, he allowing for the former 440*l.*, and I 2450*l.*, and for the latter 400*l.*, and I 4000*l.*

The materials alone of the former could not be purchased for four times the money. For this matter I need only refer your Lordship to the expense of the sea-lock at Crinan, a copy of which I had the honour of handing you in November last, and I believe it was done with as great economy, consistent with security, as possible; and I can say, in the whole course of my practice, I have never found that works, under similar circumstances, could be done cheaper. I trust, therefore, it will be allowed, that the prices I have stated are not more than what the work will cost if executed with the necessary stability.

To build works of this sort with rubble stone and common mortar would never answer the purpose. The stone should be of large dimensions and well bedded, and the front mortar made with pozzolano or terras. Common mortar does not harden if exposed to the waves, and therefore the other is necessary in front to prevent the sea-water from getting to it. If this were not to be done, the walls would be nearly as firm if built of good dry stone well squared.

I have the honour to be, &c.,
(Signed) JOHN RENNIE.

P.S. Should the Lord Provost, Magistrates, and Council determine to adopt any of the plans I have mentioned, I shall be ready to make out drawings and specifications of the different parts, with particular estimates referring thereto, and methods of proceeding in the execution of the work. These being shown to tradesmen, it will be seen at what prices they will offer, and, of course, it will be seen how far my estimate accords. If they can be done cheaper it will give me much pleasure.

No. 1.

Estimate of the expense of making a Wet Dock to contain 33,366 *superficial yards of water, or something better than six acres and three-fourths, statute measure, partly on the sands of South Leith and partly in the timber-bush, and along to the glass-houses, having its entrance from the present harbour by a lock near the old windmill. The depth of water to be* 18 *feet. The breadth of ground to be made on the north side of the dock to be* 150 *feet, namely,* 100 *feet for quays and sheds, and* 50 *feet for warehouses with a drawbridge across the lock, but exclusive of the purchase of land and other property.*

	£.	s.	d.
1st. To 164,000 cubic yards of digging to form the dock, to be laid partly in the space between the sea and dock-wall, and partly to raise the quay on the south side, at 6*d.* per cubic yard	4,100	0	0
2nd. To 101,000 cubic yards of digging over and above what will be wanted for filling the spaces between the walls and raising the quays, to be laid in the sands within the sea mark to form new ground, say opposite the glass-houses, at 7*d.* per yard	2,945	16	8
3rd. To extra expense in puddling 16,000 cubic yards, to make the dock water tight, at 6*d.* per yard	400	0	0
4th. To 1173 roods of (24 cubic yards each) sea wall along the lands and returning to the glass-houses, as represented in the plan, at 17*l.* 17*s.* per cubic rood	20,938	1	0
5th. To 660 roods of quay-wall to form the dock, at 16*l.*	10,560	0	0
6th. To 234 roods of masonry to form the lock, which must be done principally with pozzalano, or terras mortar, at 18*l.* per rood	4,212	0	0
7th. To foundations and piles for the lock gates, including said gates and a drawbridge, &c.	2,450	0	0
8th. To timber and iron for making of coffer-dams to lay the foundation of the sea-wall and lock, with a steam-engine and pumps for raising the water, including the expense of working said engine while the works are under execution; this is a very uncertain article, but say	14,000	0	0
9th. To fenders for keeping the vessels from injuring the quay walls and mooring rings	400	0	0
10th. To supervisal, utensils, and unforeseen expense, say 10 per cent. on the whole,	6,000	11	4
	£66,006	9	0

Interest of money while the works are in hand.
Purchase of lands, &c. &c.

N.B. If a middle division with a drawbridge and a pair of gates be made in this dock, its capacity

APPENDIX C

LEITH

No. 5.

Rennie, on the projected Docks.

will be a little diminished, while the expense will be increased about 3000*l*. If this dock be mad at two different times, the first half will cost about 45,000*l*., exclusive of the purchase of property and interest of money while the works are under execution.

No. 2.

Estimate of the expense of making a Wet Dock to contain 14,292 *superficial yards of water, or nearly three statute acres, between the glass-houses and buildings north of the Links, having its entrance from the other dock by an opening and a pair of gates near the glass-houses, with a drawbridge across said entrance.*

		£	s.	d.
1st.	To 168,280 cubic yards of digging to form the dock, to be laid on the sands by the glass-houses, at 8*d*. per cubic yard	5,609	16	8
2nd.	To 8680 yards of puddling and ramming the back of the quay and entrance walls, at 6*d*.	217	0	0
3rd.	To 337 roods of quay-wall, at 16*l*.	5,392	0	0
4th.	To an entrance with pair of gates and drawbridge	3,500	0	0
5th.	To fenders, mooring-rings, pumping water, &c.	750	0	0
6th.	To supervisal, utensils, and unforeseen expense and 10 per cent.	1,546	16	4
		£17,015	13	0

Purchase of land and other property.
Interest of money while the work is in hand.

No. 3.

Estimate of the expense of making a Wet Dock to contain 50,000 *superficial yards of water, or about* 10 *acres and one-third, statute measure, to be made partly on the sands of North Leith and partly in the citadel, having its entrance from the present harbour by a lock in the west pier, near the sand-port. The depth of water to be* 18 *feet. The breadth of ground which is to be made on the north-west side to be* 150 *feet, namely,* 100 *feet for quays and sheds, and* 50 *for warehouses, with a drawbridge across the lock, but exclusive of the purchase of land and other property.*

		£	s.	d.
1st.	To 107,000 cubic yards of digging to level the mounts in the citadel, to be laid on the sands to form new ground, at 6*d*. per yard	2,675	0	0
2nd.	To 150,000 cubic yards of digging in sand and clay between the north pier and citadel, to be laid between the sea and quay-walls, at 7*d*.	4,375	0	0
3rd.	To 170,000 cubic yards of digging to form that part of the dock which lays in the citadel, 51,000 of which to be laid between the sea and quay-walls, the rest to be laid on the beach to form new ground, at 8*d*. per yard	5,666	13	4
4th.	The extra expense in puddling 19,000 yards to make the dock water-tight, at 6*d*. per yard	475	0	0
5th.	To 1030 roods of sea-wall between the north point of the west pier and the citadel, and also returning within said wall to the elbow of west pier, at 17*l*. 17*s*. per rood	18,385	10	0
6th.	To 897 roods of quay-wall to form the dock, at 16*l*.	14,352	0	0
7th.	To 234 roods of masonry to form the lock, which must be done principally with pozzalano or terras, at 18*l*.	4,212	0	0
8th.	To 100 roods in return walls, at 16*l*.	1,600	0	0
9th.	To foundations and piles for the lock-gate, including said gate and drawbridge	2,450	0	0
10th.	To timber and iron for making coffer-dams to lay the foundation of the sea-wall and lock, with a steam engine and pumps for raising water, including the expence of making the same	4,000	0	0
11th.	To fenders for keeping the vessels from injuring the quay-walls and mooring-rings	600	0	0
12th.	To supervisal, &c., and 10 per cent.	5,879	2	2
		£64,670	5	6

Purchase of buildings and other property.
he works are on hand.
harbour opposite to St. Bernard Street.

No. 4.

Estimate of the expense of making that part of the Dock estimated in No. 3, *laying on the sands of North Leith, and containing* 30,000 *superficial yards of water, or about* 6¼ *statute acres.*

		£.	s.	d.
1st.	To 150,000 cubic yards of digging in sand and clay to form a dock between the west pier and citadel to be laid between the sea and quay walls, at 7*d*.	4,375	0	0
2nd.	To 51,000 cubic yards extra to fill up the same, at 8*d*.	1,700	0	0
3rd.	To extra expense in puddling between the walls and round the dock to make it water-tight, at 6*d*.	316	13	4
4th.	To 1,030 roods of sea-wall to be built between the north point of the west pier and the citadel, and also returning within said wall to the elbow of the west pier, at 17*l*. 17*s*.	18,385	10	0
5th.	To 606 roods of masonry in quay walls, at 16*l*.	9,696	0	0
6th.	To entrance lock, &c., as per last estimate	6,662	0	0
7th.	To 100 roods of masonry in return walls, at 16*l*.	1,600	0	0
8th.	To coffer-dam, steam-engine, &c.	4,000	0	0
9th.	To fenders and mooring rings	400	0	0
10th.	To supervisal, &c., 10 per cent.	4,713	10	2
		£ 51,848	13	6

Interest of money while the works are in hand. A drawbridge across the harbour opposite to St. Bernard Street.

LEITH

No. 5.
Rennie, on the projected Docks.

No. 5.

Estimate of the expense of making a Wet Dock to contain 48,440 superficial yards of Water, or about 10 statute acres to be made in the sands of North Leith, having its entrance from the present harbour by a lock in the west pier near the Sandport. The depth of water to be 18 feet. The breadth of ground to be made on the north side 150 feet wide, namely, 100 feet wide for quays and sheds, and 50 feet for warehouses with a drawbridge across the lock.

		£.	s.	d.
1st.	To 176,228 cubic yards of digging in sand and clay to form the docks and foundation of its walls, and to be laid between the sea and quay walls, and next to North Leith, at 7*d.* per yard	5,139	19	8
2nd.	To extra expense in puddling 16,000 cubic yards to make the dock tight, at 0*d.*	400	0	0
3rd.	To 1,144 roods of sea-wall to be built between the side of west pier and the west end of the citadel near the new battery wall, at 17*l.* 17*s.*	20,420	8	0
4th.	To 790 roods of masonry in quay walls, at 16*l.*	12,640	0	0
5th.	To entrance lock, &c., see last estimate	6,662	0	0
6th.	To 100 roods in return walls, at 16*l.*	1,600	0	0
7th.	To coffer-dams, steam-engine, &c., same as last	4,000	0	0
8th.	To fenders and mooring rings	600	0	0
9th.	To supervisal, &c., 10 per cent.	5,146	4	4
		£ 56,608	12	0

Interest of money while the works are on hand.
A drawbridge across the harbour opposite St. Bernard Street.

No. 6.

Estimate of the expense of making a Wet Dock to contain 24,200 superficial yards of water, or 5 statute acres, to be made in the sands of North Leith as represented on the plan No. 5, but having its entrance through the west pier near the Sandport by a lock as represented in the plan. The depth of water to be 18 feet, and the rest as in estimate No. 5.

		£.	s.	d.
1st.	To 108,000 cubic yards of digging in sand and clay, to form the dock and foundation of its walls, to be laid between the quay and sea-wall, and to raise the quay next to North Leith, at 7*d.*	3,150	0	0
2nd.	To puddling round the dock	425	0	0
3rd.	To 756 roods of sea-wall, at 17*l.* 17*s.*	13,495	12	0
4th.	To 566 roods of quay and passage walls at the end of dock, at 16*l.* . .	9,056	0	0
5th.	To an entrance lock with its foundations, gates, and drawbridge . . .	6,662	0	0
6th.	To return wall at end of lock	1,600	0	0
7th.	To coffer-dams, steam-engine and working ditto.	3,200	0	0
8th.	To fenders and mooring rings	380	0	0
9th.	To supervisal, &c., 10 per cent.	3,796	16	0
		£ 41,765	0	0

Interest of money while the works are proceeding.
Drawbridge across harbour opposite St. Bernard Street.

No. 7.

Estimate of the expense of making two Wet Docks on the sands of North Leith as per plan No. 5, to contain 48,440 superficial yards of water on 10 statute acres.

		£.	s.	d.
1st.	To 184,000 cubic yards of digging in sand and clay to form the dock, and foundations of its walls, to be laid between the quay and sea-walls and next to North Leith, at 7*d.*	5,366	13	4
2nd.	To extra expense in fetching 110,000 cubic yards of earth to make up the deficiency of the quays, at 7*d.*	2,208	6	8
3rd.	To puddling to make the docks tight	600	0	0
4th.	To 1,276 roods of sea-wall, at 17*l.* 17*s.*	22,776	12	0
5th.	To 1,030 roods of division and quay-walls, at 16*l.*	16,480	0	0
6th.	To entrance lock, with its foundations the same as before	6,662	0	0
7th.	To return wall to ditto 100 roods	1,600	0	0
8th.	To coffer-dams, steam-engine, &c.	4,000	0	0
9th.	To double pair of gates in the division walls with drawbridge, foundations, &c.	1,100	0	0
10th.	To fenders and mooring rings	600	0	0
11th.	To supervisal, &c., 10 per cent	6,239	8	0
		£ 68,633	0	0

Interest of money while the works are on hand.
Drawbridge across the harbour opposite to St. Bernard Street.

N.B.—The sections not being quite applicable to the Dock in the plan No. 5, and estimated in Nos. 6 and 7, it cannot be expected they should be quite so accurate as the others. But still it is hoped that no considerable error will be found in them.

APPENDIX C.

LEITH.

No. 5.

Rennie, on the projected Docks.

BORINGS.

	No.	Surface of the sand below the Index on the West Pier. Feet.	Inches.	Depth from the surface of the sand to the clay. Feet.	Inches.	Total depth from the level of the Index to the clay. Feet.	Inches.		Depth bored into the clay. Feet.	Inches.
North Leith	1	14	..	15	..	29	..	Sands of South Leith.	2	..
	2	13	..	14	..	27	..		1	6
	3	14	..	15	..	29	..		1	..
	4	13	..	15	..	28	..		2	..
	5	13	..	14	..	27	..		2	..
	6	13	..	15	6	28	6		1	6
	7	14	6	9	6	24	..		2	..
	8	6	2	18	..	24	2		3	3
	9	4	8	10	2	14	10		4	2
	10	4	7	11	3	15	10		2	9
	11	3	5	10	5	13	10		5	10
	12	2	2	24	7	26	9	..	Found sand only.	
	13	..	10 above	23	..	22	2			
	14	..	.. level.	23	..	23	..			
North Leith	1	19	..	10	..	29	..	Sands of North Leith.	2	..
	2	12	..	4	..	16	..		2	6
	3	14	..	1	6	15	6		3	..

In respect to the soundings marked on Mr. Ainslie's plan they were taken when the sea was a good deal agitated by the wind, and, therefore some small differences may be found in calm weather, but as they were taken with great care, it is hoped the errors will be very small.

(Signed) J. R.

To the Right Hon. the Lord Provost, Magistrates, and Town Council of the City of Edinburgh.

No. 6.

Rennie's Second Report on the projected Docks.

No. 6.

Second Report by JOHN RENNIE, Esq., *on Leith Harbour and projected Docks.*

MY LORD AND GENTLEMEN, *January* 1, 1800.

IN conformity to your orders of the 7th November last, I shall endeavour to state my opinion, in as clear and concise a manner as I can, on the best method of proceeding in the execution of the proposed wet docks at Leith, for the accommodation of the increased and increasing trade of the metropolis of Scotland, which has flourished so eminently for many years past under the magistracy of your Lordship and predecessors.

The first object which should meet the attention of your Lordship and Committee is, to provide proper stone quarries, in such situations as will admit of stones being transported to Leith at an easy expense.

I had the honour, while at Edinburgh, of proposing three situations, namely, Dysart, Starlyburn, and Rosayth Castle, all in the county of Fife. The former is situated close by the harbour, the stone is of a good quality, can be worked at a moderate expense, and the blocks can generally be taken out of the quarry and put on board ships lying in the harbour with the same crane. This situation, therefore (could the quarry be had at a moderate rent), is what I should prefer. Sir James Sinclair being abroad, I waited on his steward, when at Dysart, who said he would consult Sir James's friends and inform me of the terms; but this he did not do.

The second quarry is the property of Earl Morton, and is situated about a mile and a half west from Burntisland. The quarry is about a fourth of a mile from the sea, it lies in the face of the hill covering a bed of limestone rock, which is working for the Earl in the manner of a coal mine. At Starlyburn there is a good harbour, where vessels may enter in safety in moderate weather, and where the stone can be transported from the quarry by a railroad or inclined plane, and shipped at a moderate expense.

The Earl, your Lordship and the Committee know, has made two propositions for the use of his quarries. The one is to give the quarry free of expense if the stones are taken from the place where the limestone has not been worked, so as to uncover it. The other is to pay eighty pounds per annum for the use of the quarry above where the limestone has been got; providing the stone can be taken to Leith at any price under six shillings per ton, or to lower the rent if they exceed that sum. The stones in this situation can be raised in large blocks, but it is generally of a soft quality: therefore the outside of the sea-wall of the dock ought not to be built with it if harder stones can be got at a moderate rate.

The third quarry is situated at Rosayth Castle, about a mile and a half above the North Queensferry, on the property of the Earl of Hopeton. The stone appears to lie close by the shore, the castle stands on a projecting point, and there is a bay on each side of it, where convenient landing places might be found for vessels to lay along while taking the stone on board.

It is evident from an examination of the stones with which the castle is built, that they are of an excellent quality for standing the weather; and from examining the pier at the North Ferry, which is built of the same stone, it is equally evident that they stand in water. Therefore I do not know a stone more suitable to the purpose of building the sea-wall of the intended docks than those are. I do not know what his lordship's terms may be for the use of the quarry, but from what passed when the chamberlain and myself were with him I doubt not they will be reasonable.

Before any material proceedings can take place at Leith, one or two of these quarries should be previously agreed for. The most suitable, apparently, are those of the Earl of Hopeton and Sir James Sinclair; but this will, in some measure, depend on the terms on which they can be procured, and the ease with which the large blocks wanted for the works can be raised; for which purpose your

APPENDIX C.

LEITH.

No. 6.

Rennie's Second Report on the projected Docks.

Lordship and Committee, in case they approve of the terms on which these quarries can be had should direct workmen to open and try them, which they can do under the inspection of Mr. Sibbald, superintendent of the town works, who will report his opinion on them.

The quarries being once opened, and their comparative eligibility ascertained, agreements can be made accordingly; after which, specifications suitable to the quarries and work to be performed shall be made out and furnished.

There are three ways in which contracts may be made:—

First. A person or persons may contract for the stones, of given dimensions, and putting them free on board vessels at the respective shipping places; and a separate company may transport to Leith, and lay them down on the North Pier, adjoining where they are to be used.

Second. The contractor for the stones may also be contractor for the carriage.

Third. The contractor for the stones may also contract for the carriage and building. The latter plan would certainly be that which, on the whole, would be the least troublesome. But I doubt whether contractors could be had of sufficient responsibility to attend to all these matters. In the Crinan canal, amongst numerous trials, there was only one man who did the whole of the building of ten locks; but he has been exceedingly tedious in his proceedings, and this is a small concern when compared with the Leith docks. It therefore appears to me, if proper contractors could be got for quarrying and carrying the stones, as in my second proposal, it would be best, and others could be got to cut them, and build the walls, which, as their attention would be wholly given to the respective objects, I apprehend the work would be better and more expeditiously done.

The sea-wall, being the most tedious and of the greatest consequence, should be first begun; but in quarrying the stones, such as are not fit for the sea-wall should be removed, and paid for, if fit for the quay walls.

This would enable the stone contractor to agree on easier terms, as by that means he could work his quarry to better advantage. Care, however, should be taken that he furnish a sufficient quantity of the largest sort, to keep the men at work on the sea-wall.

The building of the sea-wall should commence in the beginning of April next, after the equinoxial gales are past. This will be a very tedious piece of work. The foundation on which it is to be built lays about 150 yards within the sea-mark. It is a hard blue till, covered with sand from about two to five feet thick, except at the north head of the west pier, where it lays deeper (from eight to ten feet). Of course this work can be carried on only at low water, which in neap tides will be but for a very short time.

The method of proceeding will be to do it in short lengths. It is not easy to say what these lengths ought to be, as they will depend on a variety of circumstances, which cannot be ascertained until a trial is made; but I advise that it be tried at first in lengths of about 20 feet. They can be increased according to the experience of the workmen, and as the water should be found easy to get out. Those lengths in the deep parts must be saved with sheeting-piles, *i. e.* short coffer-dams should be formed, having their heads about a foot or two above the level of the sand, out of which the water must be extracted by pumps or Archimedean screws, which latter, as they are less affected by sand, will be the best where the depth does not exceed five or six feet.

These screws or pumps may be worked by men, or perhaps it may be convenient to work them by steam-engines, as will be more particularly noticed in the after part of this report. The only use of the coffer-dams is to prevent the sand from getting into the foundations while the stones are laying.

The stones of which the foundation or base of the walls are to be laid should all be prepared for the respective day's work, ready to be laid down as soon as the tide leaves the place where the foundations are to be; and it will be found necessary to have three or four large flat-bottomed vessels, with cranes on them, to float to the respective situations. These to be grounded as the tide recedes, ready to move the stones wherever the foundations are cleared of water. As their operations will be tedious, they should proceed uninterruptedly, night and day, in the absence of the tide, till the whole of the sea-wall is brought to the level of the land, after which it must be carried on in regular courses, as will be described in the specifications.

The sea-wall, as will appear on inspecting the plan, commences by the north point of the west pier. This should be put in hand first, on account of the foundations lying much deeper than the rest; but other parts of the wall may go on at the same time by having extra sets of workmen; and if they are properly set out, and executed with care, they can be made to join nearly as well as if they had proceeded regularly from one end.

The outside quay wall may also be begun after the deepest part of the sea-wall is done, so that the whole may be brought to the level of the land nearly about the same time. It is not an easy matter to say how long these foundations and raising the masonry may require, as so much depends on the weather, but I doubt it will consume the greater part of two years. When once done to the level of the land, it will be much more rapid, and there will not only be longer time to work at them in the absence of the tide, but a much greater number of hands can be employed, and, having little interruption, they will of course perform much more work in the same time.

The puddle and filling up between the walls may commence soon after all the foundations of the sea and outer quay walls and masonry is carried to the level of the land. This of course will point out the time when the digging parts of the works must be let.

The sea ebbing and flowing over the filling will greatly consolidate it, therefore will so far benefit the work. About this time also preparations may be made for the inside quay walls, and they may proceed with the digging. The masonry of the walls should be let by contract to different workmen, but, perhaps, the digging of the foundations, coffer-dams, and clearing them of water may be as well in the hands of your Lordship and the Committee as on the goodness of the foundations the principal security of the works depends, and therefore, whatever it may cost, it ought to be well done, and the only way to get it so is to do it by day's work under the inspector. The rest of the digging and filling between the sea and outer quay wall may be let by contract at a specified price per cubic yard. Soon after the digging is got into a forward state the north-west pier must be opened, and the lock begun. The lock should be inclosed in a coffer-dam, and perhaps it may be found advisable to raise this dam to such a height as to keep out the sea water at all times of tide until it is finished. The coffer-dam will not be very expensive, because that part of it within the harbour will be defended from the effects of the storms by the east pier; and, without, the fury of the waves will, in a great measure, be broke by the sea-wall quay and filling between, so that the work may proceed rapidly. I expect the masonry of this cannot require more time than eighteen months; but the coffer-dams and other

APPENDIX C.

LEITH

No. 6
Rennie's Second Report on the projected Dock

preparations will take several months before the foundations can be laid. Most of these, except the clearing of water from the foundations, can be let by contract. It is in the lock and digging that the large steam-engine will principally be wanted; therefore it does not, for this purpose, become necessary to have her at present. The Crinan canal engine being now, however, for sale, and at a price greatly below the cost of a new engine, I think it may be an object worth the attention of your Lordship and the Committee. If it were possible to apply this engine to the working of the pumps or Archimedean screws while the foundations of the sea and quay walls were in hand, much money in labour and time might be saved. But the foundations are so extended, and the machines for raising the water require to be so often shifted, that I doubt the expense of the application would exceed the benefit to be derived from it. If one or two portable steam-engines, say of two or three horse power each, were to be purchased, and erected on suitable floats, or rather boats, these engines might be grounded in the sand adjoining where the work is to be done, and could immediately be applied to the screws, or to work suitable pumps, at a very small expense. I think by this means not only money but time may be saved; and if, as I doubt not, there is every reason to believe that more docks than one will be wanted, these machines would serve for the whole. But, previous to ordering them, it would be well to ascertain what quantity of water is likely to be raised; for want of this the size of the engines can only be guesswork. Preparations for the floats may, however, be going on. I have used portable engines with great success on other works, and they no doubt could be used with equal success here, if fresh water for the condensation can be procured. This leads me to a subject which I formerly mentioned, namely, the propriety of having power to take water from the head of Leith mills to supply the waste of the docks, and to keep their surface always level with the high water of spring tide. Had there been such a power in the Act it might have been used here. However, as this is not the case, and as the quantity of water wanted for the steam-engine will be very inconsiderable, I apprehend not equal to a quarter of an hour's work of the mills per day, perhaps it may not be a difficult matter to obtain leave from the proprietors for this purpose. The water can be conducted in a small trench to the citadel, and from thence, by means of a leather pipe or pipes, to the steam-engine. If this favour can be obtained, I shall not hesitate in recommending the small engine to the immediate attention of your Lordship and the Committee. If not, the men, perhaps, for the present, may come nearly as cheap.

In what I have said I believe the leading objects to be attended to in the erection of the docks have been enumerated; but there are many subsidiary ones that also require attention, such as obtaining pozzolano or terras for mixing the mortar, the purchasing sufficient timber for the framing of the gates, the sheeting piles, &c. &c.

Of all kinds of cement which have come under my observation, that made with pozzolano and good lime is the best. Agreeably to your Lordship's and the Committee's directions, I requested Messrs. Sibbald and Company to try and get some from Italy. But, should they fail in this, some other substitute must be got. Good terras I conceive to be next, and this I believe can be got tolerably easy. There is also a kind of composition manufactured in London which is a good substitute; and I hava found burnt ironstone, pounded, to answer tolerably well. If the former can be had it is preferable. But, whichever of these is to be used, particular attention must be paid to the quality of the lime, and therefore the different sorts in the neighbourhood of Edinburgh, as well as on each side of the Frith of Forth, should be examined, that the best for setting in water may be procured; for, without this, even with the mixtures I have mentioned, the cement will be but imperfect. The hotter lime, for building in water, is used, and the less exposed to the air before used, the better, provided it be properly slackened; and therefore a principal part of that which is to be constantly under water should be burnt on the spot. A lime kiln or kilns of course become necessary. They should not be of large dimensions, but should be sufficient to supply the workmen in succession as required.

Besides taking the necessary precaution in the choice of materials for the cement, great care is necessary in the manner of preparing and mixing them. It is scarcely possible to get lime sufficiently slackened in the common way without impairing its binding qualities; and it is equally difficult to procure labourers who will mix the ingredients in a sufficient manner and with little water. I have therefore, in most large works in which I have been concerned, recommended the use of machinery for that purpose.

If the steam-engine is to be purchased from the Crinan Canal Company, as she will not be wanted for nearly two years to come for pumping water, she can be employed with much advantage in the manufacturing of mortar, which she will do, not only in a much more perfect manner than labourers, but at a less expense. I expect the price of the necessary machinery for making mortar will be more than saved by the saving of labour in doing it by men, and I am sure it will render the work much more durable. But all this will in some measure depend on procuring fresh water for the condensation; for without this, unless brass cylinders and pumps are made, the engine cannot be worked to advantage, and brass cylinders, &c., would be very expensive.

The procuring of timber for the coffer-dam on moderate terms is also an object of great consideration. Memel or Norway timber is at this time very high in price. I have therefore to suggest the propriety of using Scotch fir. I apprehend abundance of this may be had in different parts of Scotland, from whence it could be transported to Leith by water.

Scotch fir, as it would be always under water, is as good for the purpose as foreign timber; and if any material saving can be made it certainly merits the attention of your Lordship and the Committee. Query—Would not an advertisement in the newspapers bring forth information on the subject?

The oak scantling for the gates need not be inquired after for the present; but, about the end of the year 1800 or beginning of 1801, it should also meet your consideration. Many of the pieces will be large, and cannot readily be had at once. Much of this kind of timber is brought down the Humber; and if some person were to contract for the supply, they would naturally take the proper opportunities of picking up such pieces as would be wanted on the best terms.

Several large pieces of Danzig timber will likewise be wanted for the head and tail sills and sheeting of the lock, and also for the division gates. Those I marked at Leith in November last were very suitable, and I hope they have been purchased at a moderate price.

Your Lordship and the Committee will readily see that a number of other things will arise in the course of the proceedings in the execution of the works, and which would extend this report beyond what is necessary in the present stage of the work. I trust what I have said is sufficient. I shall attend, in the progress of the work, to such other matters as may present themselves, and advise your Lordship and the Committee from time to time respecting them.

APPENDIX C.

LEITH.

No. 6.
Rennie's Second Report on the projected Docks.

One material point, however, still remains to be urged, and that is, to get, as speedily as possible, an able, honest, and assiduous inspector. Such I trust will be found in the person to whom I spoke, as desired; and I have transmitted his terms to Mr. Gray, which your Lordship and Committee, I expect, have seen.

The sooner you make up your minds to employ Mr. Patterson, or some such person, the better, that he may make preparations to attend the works as early as he can in their progress.

So soon as money is procured to justify your Lordship in giving directions about proceedings, specifications and plans of the different works to be done shall be put in hand.

I have the honour to be, &c., &c.,

JOHN RENNIE.

To the Right Honourable the Lord Provost of Edinburgh,
and Committee for carrying into execution proposed
Wet Docks at Leith.

Specification of the Stores wanted for the Sea and Quay Walls of the proposed Docks at Leith.

March 8, 1800.

1st. The whole front of the sea-wall to be of ashlar, and all headers to be on an average 5 feet deep in the beds, but no stone less than 3 feet 6 inches. Of course some stones will be 4 feet deep, some 5 feet, some 6 feet 6 inches, and all intermediate depths. The average lengths of their face to be 2 feet 6 inches, but no stone less than 18 inches. None of the courses to be less than 15 inches thick, but as much thicker as the quarries will produce, each course being of one thickness throughout; but if the quarries will turn out stones of larger dimensions they are to be furnished accordingly.

2nd. The inside and packing courses to be of the same thickness as its corresponding face course, none of which must be less than 3 feet 6 inches long by 18 inches broad, but as much larger as the quarries will produce.

3rd. The front courses of the quay walls must be composed of ashlar, header, and stretcher. The header to be 3 feet 6 inches deep in the bed on an average; but no stone less than 2 feet 6 inches by at least 2 feet long in the face. The stretchers to be on an average 2 feet deep in the beds, but no stone less than 18 inches. The headers must be 5 feet asunder, and no stretcher must be less than 2 feet long in the face, and no course less than 9 inches thick.

4th. The backing and hearting courses to be of the same thickness as the front, and not less in depth than 2 feet on an average, but no stone less than 18 inches; and to have headers of 3 feet deep, corresponding to the spaces between the headers in the front of the wall. A small quantity of good rubble stones will be wanted for this wall.

5th. The coping courses of the quay walls is to be 5 feet deep in the beds, and from 3 feet long in the front to as much greater lengths as the quarries will produce, and 15 inches thick.

6th. All the stones must be cut out of the quarry so as when laid on the walls must lie on their natural beds, and they must be shaped as near to the size as possible by the hammer, so as to save unnecessary expense in carriage, and to make full joints.

7th. The contractor must engage to furnish the stones as expeditiously as wanted for the works, otherwise he must incur a penalty equal to the injury sustained by the contractor for the masonry; and he must load the vessels in the harbour of Rosayth with all diligence as they arrive, and which loading must be included in the price of his contract.

8th. The quarry must be all worked in a complete and regular manner to the satisfaction of the engineer, or such inspector as the Lord Provost of Edinburgh and Committee for conducting the execution of the docks may choose from time to time to appoint, and all the stones delivered must be of shape and quality to his satisfaction, and to the true meaning of this specification, and if it should appear, at any time during the existence of the contract, that the contractor is not working the quarry, or furnishing the stones to the satisfaction of said engineer or inspector, he shall give notice in writing of the same, and should the contractor, after such notice is given him, fail to comply therewith, the said engineer or inspector shall stop the work, and, unless the contractor can show him satisfactorily that he can and will remedy, in future, the deficiencies complained of, the engineer or inspector shall have it in his power to discharge the contractor from the work and take the contract out of his hands; the value of tools and materials being previously settled by the principal engineer of the works, or such other respectable engineer or architect the said Lord Provost and Committee may choose to appoint for that purpose, whose determination shall be final.

9th. If any misunderstanding should take place about the meaning of any part of the foregoing specification, the same shall be settled by the principal engineer.

10th. There will be about 125,000 cubic feet of front ashlar wanted for the sea-wall, and about the same quantity of backing and hearting.

About 80,000 cubic feet of ashlar for front of quay-walls, and about 90,000 cubic feet of backing and hearting. But should the Lord Provost and Committee choose to direct that more stones than the above mentioned quantities be quarried, the contractor shall be obliged to do so, or, if less, to stop him.

The stones for the sea-wall will be wanted first. The contractor to give proposals for quarrying and putting the stones on board in Rosayth Harbour, and a separate proposal for the carriage and delivery at Leith.

JOHN RENNIE.

No. 7.

Report of WILLIAM CHAPMAN, Esq., *Civil Engineer, &c., relative to the Improvement of the Harbour of Leith.*

No. 7.
Chapman, on the improvement of the Harbour.

MY LORD AND GENTLEMEN, *Edinburgh, October* 1, 1824.

PREPARATORY to my entering into any description of what I conceive to be the most expedient means for the improvement of Leith Harbour, I shall proceed to relate its chief defects, viz. —

1st. That, in all gales from the N.E. and N.W. quarters, the sea is invited into the harbour by the trumpet-mouth form of the entrance between the pier and the dock-walls; in consequence of which, the waves intercepted at the entrance, being progressively contracted to a very narrow space, compensate their deficiency in width by a dangerous accession of height, rolling impetuously into the harbour, so as to cause vessels to be insecure so far up as the second drawbridge, and more especially so farther downwards.

APPENDIX C.
LEITH.
No. 7.
Chapman, on the improvement of the Harbour.

Under this predicament, it is not only impossible for vessels to proceed to sea, but even those attempting to enter the harbour have occasionally been wrecked, or much damaged, by beating against the walls bounding the dock.

2d. Through want of sufficient extent of the pier, which (including 1100 feet length of low weir to guide the channel) falls about 1400 feet short of low water-mark, the current of the efflux of the harbour through that intermediate space necessarily loses its power, and diffuses itself into various shallow channels, either to the eastward or the westward, according as the prevalent winds may have accumulated a bank of sand on one side or the other.

3d. The quantity of land water, usually discharged by the river of Leith, is too inconsiderable to produce any essential effect in keeping the channel open; and it is only in great speats that it can operate powerfully; and, although they seldom occur, they are of vital importance, as they impetuously scour away those accumulated obstructions, on which the equalized current of the stream could produce no effect. In fine, those speats do more than remove the injurious effects arising from the baneful practice of individuals throwing rubbish of various kinds into the river, that it may be carried off without expense to themselves. This practice is contrary to the general law of the land, because injurious to a navigable river and harbour, and certainly requires prevention with the utmost rigour. Thus, unfortunately, the otherwise laudable plan of improving the mill property on the water of Leith, by equalizing its discharge, militates strongly against the interests of the harbour.

I purposely deferred my visit to Leith until the period of the equinoctial spring-tides, which, from their having ebbed low enough to lay all the strand dry to a little without the Mortella[*] Tower, enabled me, on three successive low ebbs, to make the necessary examinations, and to obtain, by the aid of Mr. Brown, your Superintendent, a correct plan of the whole premises. The only points remaining to be ascertained are the depths (in the line of the proposed piers) from the surface of the sand to the substratum of clay or of gravel beneath it; and also the force and direction of the flood and ebb currents at different periods of the tide; for the obtaining of which I have left minute instructions.

The information I have already obtained is to the following effect, viz. That the tide gauge at the end of the pier is graduated upwards from the level of the low weir, which confines the direction of the current, and prevents its assuming an eastern direction, which the set of the ebb current of the Frith inclines it to take: That the channel on the west side of the weir is from 18 inches to 3 feet below the surface of the weir; but that where it diffuses itself and takes several directions (perpetually varying and impossible to be followed), the wide sand beach (excepting in these channels) is for the most part only a foot or 18 inches below the level of the weir; whilst the low water in the channel of the Frith is, in good spring-tides, from 4 to 5 feet below the commencing point of the pier-gauge (viz. below the weir). On Thursday morning, the 23d instant (September 23, 1824), it was 5 feet 2 inches below it.

In neap-tides the sands mentioned between the weir and Mortella Tower are covered at low water. I have also to observe that there is a sand bank or ridge, dry at low water in great spring-tides, extending from the westward of the Mortella Tower to near Newhaven Pier, whilst, at the same time, a great extent of water is visible between that ridge and the shore westward of the dock walls.

The flow of the tides, according to the account with which I have been favoured by Mr. Crichton, is as follows, viz.—

		Feet.	In.
Very highest spring tides, the depth of water in the channel is		17	9
High spring tides		15	0
Ordinary spring tides		12	0
High neap-tides		11	0
Ordinary ditto		10	0
Lowest ditto	barely	9	0

These depths are assumed from 18 inches below the weir at the foot, or commencement, of the pier-gauge.

Mr. Crichton further observed, that the ebb of the Frith sets very strongly over the sands within the Mortella Tower.

Having now described, not only the chief defects of the harbour, but also the leading circumstances that have reference to it, I shall proceed to give my opinion on what is requisite to be done to produce an efficient result, consistently with due regard to the funds likely to be obtained for carrying the measure into effect.

In the accompanying plan, it will be seen that I have projected a continuation of the north pier, in a straight course along the line of the weir, to the extent of 1200 feet, and that from thence it curves gently outwards for a little above 900 feet; after which, in a tangent from the curve, it proceeds to the low-water line of the Frith, which it enters at about 100 yards west of the Mortella Tower, clear of all the rocky ground.

If it were not for the essential aid expected from directing the force of the ebb current of the Frith along the projected channel from Leith Harbour, I should have been inclined to recommend an outward direction a little more northerly, as being better suited for the entrance of vessels in the prevalent winds; therefore, if the result of the examinations relative to the force and direction of the current over the sands within the Mortella Tower during the ebb be not what I have been given to expect, I should recommend the outward portion of the pier to follow nearly the dotted line A B, marked in the plan, which quits the curve nearer its southern commencement.

The proposed purpose of this pier is evidently to conduct the ebb current, in a regular channel, to a little without the Mortella Tower, and to enable vessels to be tracked either inwards or outwards. So far it would have a good effect; but, if unaccompanied by other works, it would render the harbour much more unsafe than it is, because it would more than double the width of the trumpet-mouth; and, in all high winds that send sea into the harbour, the waves would, from this contraction, rise to an uncontrollable height, similar to the wave of tide in Bristol Channel, which near its entrance rises in spring tides little more than 20 feet; but, from its progressive contraction, attains at Newport and Chepstow the vast height of upwards of 50 feet.

From this cause alone a pier from the N.W. point of the opening for the indraught of the waves is absolutely requisite: and still further so from the beneficial results which I shall shortly detail.

In the plan it will be seen that I have drawn a pier from near the salient angle of the N.W.

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[*] Mortella, so named from the well-known tower on the north-western coast of Corsica, which, with a single gun, beat off the *Fortitude*, 74 guns, Captain William Young, and not Martello, as it is commonly spelt.

Appendix C.

Leith.

No. 7.
Chapman, on the improvement of the Harbour.

bastion of the dock-wall, running (except 120 feet at its extreme end) in a line E.N.E. towards a point 200 feet distant from the line of the east pier, and 1300 feet without the end of the present stone pier. To the extent of 120 feet short of its extremity, this west pier is proposed to be constructed principally of the tumbler stones scattered along the coast, to the height of 11 feet on the pier-gauge, in such manner as will shortly be described; and the remaining 120 feet pointing farther outward, in an angle of about 14° (from which vessels may set sail in a westerly wind), is proposed to be formed similarly to the projected eastern pier, the construction of which will be of timber, filled up with stone to an equal height with the stone mound from the end of the dock-wall; as also should be the wooden part of the present east pier, between the shore and the part built of stone.

Before giving a detailed description of the pier, I shall mention the beneficial effects that will clearly be deducible from the measures I have recommended, viz —

In the first place the harbour will be rendered perfectly tranquil, unless from a little agitation, when the sea, in stormy weather, bearing on the coast, shall in spring tides wash over the stone breakwater pier, and over the stone filling of the same height in the wooden pier; the chief effect of which (as the contents of these surmounting waves must pass out through the 200 feet opening between the piers) will be to generate a strong outward current, and deepen that entrance and the channel immediately above and below it.

2dly. An addition will be made to the harbour of nearly 23 Scots acres, exclusive of the channel by the east pier; which accession of space will be more than triple the magnitude of the present harbour, and be very convenient for the discharge of timber vessels, &c.

3dly. The filling of this area and the adjacent channel, in every tide, will, in high neap tides, (viz. those level with the breakwater) occasion an influx through the opening of nearly 15,000,000 cubic feet of water, which, exclusive of widening and deepening the whole channel, will generate an in-draught on the flood-tide, sufficient to accelerate the vessels into safety, into which, from the proposed projection of the harbour-mouth, they will arrive, from the low water of the Frith, through a space less than half of what they pass through at present; and through that outer portion they will have a regular channel, through which, as circumstances may require, vessels entering the harbour may either sail or be tracked. Both inwards and outwards of the contracted space between the West Pier and the East Pier, the channel will tend to diffuse itself, and may, for some distance, more or less, require to be restrained by a low weir, nearly level with the adjacent strand, formed either of picketed bavins, or similarly to your present weir, but in such a manner as vessels may receive no injury from grounding upon it.

The outward current may occasionally be aided by sluicing from the docks about an hour before low water. The upper part of the harbour, above the lowest drawbridge, cannot be made use of as a scour without great preparatory expense; besides which, no large quantity could be penned without injury to the saw-mill at the head of it.

Although the most effectual and economical mode of obtaining and continuing such depth of water as may be required, is by directing the operations of nature in such manner as to produce that effect, yet such hard and compacted shoals as cannot be removed by those means, must necessarily be cut through by ballasting in the channel; which, in the present instance, is fortunately requisite to a considerable extent for the ballast of ships, and will be still more so when the harbour is improved.

It is impossible to determine what additional depth may be acquired by the projected measures; but it probably will be from two to three feet or upwards.

Those substances, carried down by the current from the harbour, that are capable of forming a bar, would necessarily rest beyond the end of the pier, were it to stop short of the line between the Mortella rock and the low-water strand to the west of it; but, being carried thus far, there is a moral certainty that the strong tides of the Frith would disperse them.

General Description of the proposed Pier.

As there are abundance of heavy tumbler stones dispersed on the strand, sufficient for outside facing, and great plenty of smaller stones for filling the interval between them, I recommend the adoption of the form of pier constructed at Scarborough, about the reign of Queen Elizabeth, which withstood the force of waves much more heavy than on the coast under discussion; and has only been taken down because of the extension of piers without them. They were formed of stones rounded by the sea, which were piled up in two walls, battering 8 inches to the foot in height; and their intermediate space filled with smaller stones, and with clayey gravel and sand, to fill their interstices. On this principle, and according to a plan and section left with Mr. Brown, city superintendent, the cost of 1050 feet length of this pier will, as by the estimate, amount to only 6000*l*.

The wooden pier I recommend to be constructed of larch, or of Riga, Memel, or Dantzic fir, according as any of those denominations may be had at a reasonable price, and after a form that I have used elsewhere, viz.—the principal parts forming two conjoint triangles, the outer one standing on its base, and the inner one on its apex, being formed by a style nearly vertical on the channel side; and by the inner limb of the outer triangle, from the apex of which, to the style on the channel side, a cross brace sustaining an open gangway of battens for suffering high waves to pass up through them. On the inside of the exterior line of triangular frames, longitudinal and horizontal scantlings will be placed, sufficient to retain a mass of rubble-stone to its due height. That height, as already mentioned, will be 11 feet above the foot of the pier gauge, from the new entrance inwards, and from the entrance outwards 8 feet height will be sufficient.

Plans and sections will be left of the whole construction of this pier; therefore it is unnecessary to say more than that the outer side of the gangway will be protected by a strong rail, and the heads of the inner styles of the pier will be covered by a cap-piece, extending the whole length, for the towing-rope to slide over.

Although wooden piers have less duration than those built of stone, yet the economy attendant on their construction has caused them to be much used on both sides of the English channel, and in Flanders and Holland.

They are, in salt water more particularly, and in the different species of fir timber, more than in oak, liable to be injured by what is usually denominated the worm,—not the *teredo navalis*, but a very small insect of many legs, with a head calculated for boring and gnawing timber. In some harbours that have no fresh water passing through them their destructive process is rather rapid; but it may be almost totally prevented by various means; one of the most effectual of which is, to bream the timber, and to impregnate it, when heated, with a mixture of whale-oil and thin coal-tar.

No. 7.
Chapman, on the improvement of the Harbour.

By the annexed outline of an estimate, it will be seen that the probable cost of the projected works (which are planned as consistently with economy as is accordant with due strength and duration) will amount to 41,600*l.* which exceeds (by 21,600*l.*) the sum which you, my Lord Provost, the Magistrates and Council of Edinburgh, have proposed to appropriate to this purpose; but will, I trust, not prevent the execution of this project, so highly beneficial to the public at large, and more especially to the city of Edinburgh and town of Leith; the latter in the greater degree, as it will raise the value of their warehouses and other premises from their present depreciated state to that of great prosperity, which will or ought to induce both the residents and proprietors of land and houses to devise such means of raising a fund in aid of the requisite expenditure as shall not deter either vessels or merchandize from entering the port.

The boats from his Majesty's vessels in Leith Roads have sometimes been sunk in passing Leith Bar, which has occasioned Newhaven to be preferred for the shipment of naval stores, for which it is very convenient in easterly winds, but is much exposed in gales from the N.W. It has very properly been observed to me, that if a communication were made through the walls of the N.W. bastion of the dock, to lead on to the projected west pier, and a wooden platform of sufficient height raised upon it, convenient means for shipping naval stores would then be obtained, in a private uninterrupted situation, and in a safe barbour, from whence, at all proper times of tide, access could be had to and from his Majesty's ships.

It has also been intimated (to which no objection can arise but that of increase of expenditure) that, if the east pier were carried in open frame-work into 5 feet depth of water in spring tides low water many of the steam-boats would prefer, before any other place, the landing of their passengers there, and taking them from thence. The propriety of this depends on the proportionate advantage or revenue derivable from the additional outlay. There is only one other point of consideration that I have to offer to your notice, which is, that, as Leith harbour, when improved, will be highly beneficial to the public, not only for the reasons already stated, but because of its affording safe lying for such revenue cruisers as can bear the ground, or may come into the docks for necessaries or repairs, therefore his Majesty's ministers may, on a due representation of these various advantages, see it advisable to remit the duties on such foreign timber as shall be used in the pier.

I have, &c.,
WILLIAM CHAPMAN.

To the Right Hon. the Lord Provost, the Magistrates,
and Council of the City of Edinburgh.

Estimate of the Improvement of Leith Harbour, according to the Current Prices of Materials and Labour.

1030 feet length of western or breakwater pier, at 4*l.* per foot .	£4,200	0	0
120 feet length of wooden pier at the termination of the stone-work, similar to the east pier, at 8*l.* 7*s.*	1,002	0	0
2550 feet length of wooden east pier, filled with stones, as described in the report, at 8*l.* 7*s.*	30,343	0	0
Weir to prevent the diffusion of the channel, uncertain in its extent, assumed as 2000 running feet, at 3*s.* . .	300	0	0
Removing indurated impediments in the channel, incapable of being scoured away by the current, uncertain, say . .	300	0	0
	36,145	0	0
Incidents, superintendence, &c., 15 per cent. . . .	5,442	0	0
Total . .	£41,587	0	0

No. 8.

No. 8.
Stevenson, on Leith Harbour.

Statement relative to Leith Harbour, being an excerpt from a Memoir on British Harbours, drawn up in the year 1824. By R. STEVENSON, Esq., F. R. S. E. & M. W. S., &c., Civil Engineer.

IT is familiarly known that the Frith of Forth is a principal rendezvous for shipping during the storms which affect the eastern coast of Great Britain; and as a naval station, especially in the event of war with any of the northern powers, it is of primary importance to the best interests of the nation. To those who are not locally acquainted with this great estuary, we may notice, that its access is obvious, and its navigation easy. Leith Roads, which afford its chief anchorage, are ample and commodious, possessing a soft bottom, with a depth of water varying from 3 to upwards of 7 fathoms, and, for larger vessels, to 16 and 18 fathoms. Connected with this extensive roadstead there are other valuable mooring grounds above Queensferry, which resemble the higher parts of Plymouth Sound and Portsmouth, in regard to the shelter and security which they afford to shipping.

Leith Harbour, the subject of the present section, is situate on the southern side of the roads above described, at the embouchure of the river Leith, about two miles north from Edinburgh, of which it is the port. The advancement of this harbour is consequently an important object with the corporation of that capital, and also with the constituted authorities of the town of Leith. I am now, therefore, to give some account of it, and to state what appears to me most suitable for its improvement.

At high water of ordinary neap tides there is a depth of only about 8 or 9 feet at the present entrance of Leith harbour, and in spring tides the depth is about 13 or 14 feet. From the peculiar form of its piers, and particularly owing to a considerable extension of the eastern pier beyond the western one, as will be seen from the accompanying sketch-plan, vessels are by this means often shut up for a length of time with north-westerly winds. Till of late years the berthage of the harbour was confined to the bed of the river, and had become so extremely incommodious from the increase of shipping, that its enlargement became indispensable. An additional revenue was accordingly provided; and two spacious wet-docks, extending to 10 acres, were formed. These docks have proved a vast accommodation to the port; but a great desideratum still remains in the want of a sufficient depth of water, and a more commodious entrance for the reception of large ships.

APPENDIX C.

LEITH.

No. 8.
Stevenson, on
Leith Harbou

If we enquire into the cause of the shallowness of the water at Leith, and generally along the southern shores of this frith, it may be accounted for, on the great scale, by the set both of the flood and ebb tides, in the following manner. The strongest current, for example, of the flood tide, in its course from the Atlantic Ocean, runs along the coasts of Caithness, Aberdeen, and Kincardine, to the higher parts of the Frith of Forth, meeting with comparatively few obstructions on the northern side; whereas the stream of tide which supplies its southern shores, separates off St. Abb's Head, in Berwickshire,—one branch of the tide proceeding to the English coast, and the other along the Lothians up the frith. This last, however, has more the character of an eddy-tide, having changed its course almost at right angles, at or near St. Abb's Head, and being further intersected in its progress by the Bass and other islands lying off the coast of Haddingtonshire. At Gullen Ness, which forms one of the chops of the inner part of the frith, the channel suddenly expands into the comparatively great bay of Musselburgh. This expanse gives another check to the velocity of the tide, which at Leith is again obstructed by a chain of rocks extending toward Inchkeith, throwing the currents, both of flood and ebb, still off the southern shore. Between Leith and the Narrows at Queensferry, the incumbrance is continued by the interposition of Cramond Island and the foul grounds of Mickery and Oxscares, which altogether are favourable to the process of deposition on this shore; while the force of the current and consequent depth of water are increased upon the northern side. Of this we have an anomalous example at Queensferry, where the soundings are about 35 fathoms in depth, and consequently greater than on the same parallel of latitude any where between the Frith of Forth and the opposite coast of Denmark.

The great obstacle to the improvement of the present entrance of Leith harbour arises from the extensive flat or bank trending northward to the rocky grounds called the Symonds, lying seaward of the Mortella Tower, as delineated on the annexed sketch of the shore between Leith and Newhaven, showing the figure of the bank and the position of the respective rocks in the offing. On the southern side of the frith, immediately above Newhaven, the scouring effect of the tide is chiefly with the ebb, and thus we account for the peculiar form of the sand-bank off Leith, and the greater depth of water off Newhaven: at this place the bank is comparatively narrow, and it attains its greatest breadth off the entrance to Leith Harbour.

The scouring effects of the river Leith are, no doubt, beneficial to its alveus; but if we carefully examine this matter, we shall find, from the extent and flatness of the ground, that its influence is, upon the whole, languid. The bar does not consist of mud, but of sand, similar to that which is deposited above and below Leith. It is not a particular ridge, but an extensive flat, which has its origin in the local set of the tides, arising from the configuration of the shores opposed to the tidal current. I am therefore of opinion, that every effort to deepen the present entrance of the harbour, which stops short of carrying two continuous piers, at a very moderate distance from each other, seaward of the Symond Rocks, or to the extent of about a mile from the shore at Leith, will not only prove ineffectual, but that one pier, of any form, which extends much beyond the other, will prove ruinous to the best interests of the port. I would not, however, be understood as recommending so extensive a plan of operations, as the extension of piers to the Symond Rocks, but merely as stating what humbly appears to be the only practicable mode of deepening the present entrance to the harbour of Leith.

In quest of this object, some have projected the extension of a single pier, in various lines of direction, toward the Mortella Tower, as a weir to the current. Others, with somewhat more plausibility, carry two piers to a certain extent over the sandbank, and then proceed with one pier to the Mortella Tower, as shown in dotted lines upon the plan. I confess that I have never been able to satisfy myself upon this point, either as to its beneficial effect upon the bar, or its proper influence upon the accessibility of the harbour. To illustrate this, we simply refer to the present state of things. For example, every one conversant with the nautical localities of Leith knows the difficulty experienced in leaving the port with north-westerly or favourable winds down the frith. In such cases, a vessel must *cast off*, or make sail, from the western pier, beyond which the eastern one projects about 100 yards. But let us imagine that this single pier were extended to a mile, or even 1000 yards, and then, according to our views of seamanship, the difficulties attending the access of the harbour would be increased tenfold; or, as before noticed, "it would prove ruinous to the best interests of the port."

To obviate this state of things, it has been proposed to project a pier from Newhaven, till it meets the continuation of an eastern pier beyond the Symond Rocks, or seaward of the Mortella Tower. By this means several hundred acres of the sand-bank, which dries at low water, would be included in the form of a great outer harbour. In this case, it appears to be impossible to avoid the silting up of so large a space as would thereby be included by the two piers projecting respectively from Leith and Newhaven, while the effect of the winds, at high water, upon a surface of about one mile in breadth, would render it extremely difficult to transport vessels through it, to or from the interior harbour. It is therefore to be feared, that, after having expended a very large sum in either of these diversified operations, we should only have an incommodious, if not impracticable, harbour.

Having made these observations on the set of the tides, and the natural situation of Leith harbour, in allusion to various plans latterly suggested for its improvement, we shall now endeavour to inquire into the effect and tendency of executing in whole, or in part, the apparently abandoned plan of the late eminent Mr. Rennie, and upon which, it is believed, upwards of 200,000*l.* have already been expended. When Mr. Rennie was consulted on this subject, about the year 1800, he had before him an early design by Mr. Whitworth, a celebrated engineer of his day, who had proposed to extend the berthage of the harbour, by following the course of the river above Leith Saw-mills. But when Mr. Rennie maturely considered this subject, and took into view the natural difficulties which present themselves, to forming a deep-water entrance to Leith harbour, from which the tide ebbs to the extent of about 1 mile, he was properly induced to form a design suitable for vessels of a greater draught of water than were generally in use in Mr. Whitworth's time, by opening a communication at Newhaven.

Now, as the greatest breadth of the sand-bank above alluded to is immediately off the present entrance to Leith harbour, and as the bank becomes narrower as we approach Newhaven, a more commodious line of direction is evidently by the erection of a continuous sea-wall toward Newhaven; where a sufficient depth of water may be obtained for His Majesty's ships of war. After therefore consulting with that eminently scientific navigator, the late Captain Huddart, who made a survey of Leith, Mr. Rennie ultimately determined upon placing the deep-water access to the harbour near Newhaven, as delineated in dotted lines upon the accompanying plan. I have endeavoured to give the subject of the improvement of this harbour every possible attention, and I am humbly of opinion that no design for this purpose has yet been submitted to the public, which seems to warrant the total abandonment of Mr. Rennie's plan. I am also confident that it may be satisfactorily shown, not only to be the best which, under all circumstances, can now be followed. but also that the least expensive mode of obtaining a deep-water entrance is to continue the sea-wall from the docks westward; for I do not now propose a suite of docks from Leith to Newhaven, but merely a *tide-harbour*, which might be occasionally scoured from the present wet-docks. To take a practical example of this, let it be observed that a sea-wall from the wet-docks toward Newhaven would not be more than two-thirds of the extent of the pier required, to carry a ship to a similar depth of water off the Mortella Tower, as may be seen from the accompanying plan.

We are aware that the proposed entrance at Newhaven is distant from the chief seat of business in Leith, and that it is difficult for those accustomed to the present state of things to look favourably upon any other view of the subject; but, in point of fact, the pier-head near Newhaven would not be more distant from the central parts of Leith than a pier at the Mortella Tower, while the former would be much more commodious and accessible than the latter. In every extended port, more or less inconvenience of this description is felt; and if the situation of the merchants of Leith be contrasted with that of their brethren of London, Liverpool, Dublin, and many others, they will appear to have little cause to complain, although the entrance of the harbour were at Newhaven.

Upon the whole, I hesitate not to recommend that the entrance to Leith harbour should forthwith be improved upon a moderate scale. Its present condition is a source of much inconvenience to the trade of Leith, having perhaps as difficult and awkward an access as I have anywhere met with in the whole course of my survey, and personal observation, on "British Harbours" between the Shetland and Scilly Islands. I am further of opinion that a sea-wall should be extended from the wet-docks toward Newhaven, and that a deep-water entrance should there be formed, upon the principle, if not the form, suggested by Mr. Rennie. This, as formerly stated, I conceive to be the most proper and convenient mode of acquiring a sufficient depth of water, and also the most economical mode of improvement of which the port of Leith is susceptible.

No. 9.
Report of the Committee of the Inhabitants of Leith.

No. 9.

Report of the Committee of Inhabitants of Leith, to General Meeting of 20th March, 1827.

Leith, March 19, 1827.

THE Committee of the Inhabitants were, on the 16th inst., favoured with the perusal of a Report addressed to Lord Melville by Mr. John Rennie, Civil Engineer, on the subject of the plans for the improvement of Leith Harbour.*

Aware that the public discussion of the matters contained in Mr. Rennie's letter could not fail to widen the breach already existing between the Town Council, and the Shipping Interests, and inhabitants of Leith,—the Committee had intended, in the first instance, to address to Lord Melville a few remarks connected with the local circumstances and trade of the port, which they hoped would convince his Lordship of the inexpediency and impracticability of the plan of Mr. Rennie, and that all further delay in the execution of the plans already sanctioned by Act of Parliament might be prevented.

But some proceedings of the Town Council of Edinburgh within the last two days have prevented that intention being followed out, and having rendered an immediate appeal to the public on their municipal and police affairs indispensable, the Committee of inhabitants could not, with propriety, withhold from that public meeting the present aspect of the affairs of the harbour.

1st. Mr. Rennie has revived the idea of a new entrance to the docks at Newhaven pier, and he states, that by making a new entrance there, a depth of 28 feet water at spring tides will be acquired; while in the entrance proposed by Mr. Chapman, there will be only 19 feet 6 inches, including the 2 feet 6 inches which he admits will be gained by the extension of the eastern pier.

In answer to this, the Committee have to state, that since the construction of the docks, and of Newhaven pier, a bank has risen, or rather has increased, in a line drawn from the Mortella Tower to a point about 300 feet north-east of Newhaven pier; and that instead of there being eleven feet more water over that bank than in the present channel of Leith harbour, there is not a difference of more than four feet, so that when even two feet six inches shall be gained in the present entrance, there will be a depth within eighteen inches of that which could be obtained by Mr. Rennie's plan.

2nd. Mr. Rennie objects to the liability of filling up, and the necessity of constant dredging.

In answer to this objection, the Committee have had the experience of what has been already done, by means of a very imperfect weir for confining the channel of the river, aided by a very inefficient ballast establishment; and so far from the facility of deposit being increased by the eastern and western piers, the plan of their construction is admirably calculated to prevent any great accumulation of sand between the piers,—for while the easterly as well as the westerly sea will be sufficiently broken by the sloping stone breakwaters and timber-work rising above them, to prevent inconvenience to the shipping, the quantity of water rolling over them at particular times of the tide will operate as a powerful scour in its egress through the narrowed entrance formed at the point of the western pier.

But even were the expectations of Mr. Chapman not to be altogether realised as to this effect being produced over the whole space, the Committee never understood it to be in contemplation that vessels of war were to lie alongside of the outer quay, or of the proposed western pier; on the contrary, it appears in Mr. Crichton's letter of 26th October, 1824, addressed to Lord Melville, that the original plan for the naval yard merely referred to the advantages of adding to Mr. Chapman's stone breakwater, a platform or gangway, for the purpose of enabling the *boats* of His Majesty's ships to communicate directly with the naval yard, instead of landing at the public quays; and in the same letter it is stated, that one of the advantages of that plan for the naval yard will be, "that in the case of stores or supplies requiring to be sent off in decked lighters, they could be at once removed from the store-houses to the lighters lying afloat in the wet dock.

3rd. Mr. Rennie next alludes to the great expense of Mr. Chapman's plan, and expresses his fears that the eastern pier would not be done for less than 60,000*l*., and the west pier for from 35000*l*. to 40,000*l*., besides the dredging apparatus, and 10,000*l*. for the boundary sea wall of the naval establishment; and besides the naval buildings, for the purpose of lowering the bar about two feet six inches, which, he adds, for such an inconsiderable advantage is certainly a very large sum.

It is true, that by means of objections started by the opponents of Mr. Chapman's plan, and of alterations made on the eastern pier, for the purpose of relieving the Town Council of Edinburgh, in a

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[*] For this Report see Supplement.

APPENDIX C.

LEITH.

No. 9.
Report of the Committee of the Inhabitants of Leith.

great part, from the expense of upholding it hereafter, an obligation for the discharging of which they are not only in receipt of large revenues, which strictly are applicable to the enlargement and maintenance of the harbour, but which they also specially undertook in consequence of receiving a most advantageous loan from the public, the expense of that plan has been increased considerably beyond the original estimate. But even with these alterations, there is no doubt that if advantage be taken of the present low prices of materials and labour, the work may be executed at or under 36,000*l.*

It is admitted by Mr. Rennie, that the western pier is only half the length of the eastern pier, and yet although it is completely sheltered from the heavy sea to which the eastern pier is exposed, and is not subjected to the collision of large vessels entering or leaving the harbour, yet to swell up the estimate he states the probable expense at about two-thirds of the eastern pier.

The Committee feel warranted in asserting, that for every purpose connected with the improvement of the eastern entrance, and for the use of boats landing from His Majesty's ships, the western pier should and can be constructed at one-third less than the eastern one, in proportion to its length, or for a sum not exceeding 12,000*l.*

The other means by which Mr. Rennie has succeeded in swelling the estimate for Mr. Chapman's plan up to nearly 120,000*l.*, are by including the dredging apparatus, and 10,000*l.* for the boundary sea wall of the naval establishment.

The dredging apparatus is already provided, and nearly prepared for being set to work in deepening the channel where the greatest depth is required; in its operations in the eastern entrance it will be greatly assisted by the run of water from the river, when guided by the extension of a pier into the tideway of the Frith of Forth, while any entrance to the westward must be kept open by dredging alone; but the most extraordinary item included to make up the 120.000*l.* to be expended, as Mr. Rennie says, *for the purpose of lowering the bar about two feet six inches*, is the sum of 10,000*l.* for the boundary sea wall of the naval establishment.

By expending this sum to take in a piece of ground in a most eligible situation, but which is at present laying waste, Government are enabled to dispose not only of the present naval yard and ground on which it is situated, which will bring a considerable sum, but are also enabled to dispose of the property purchased by them at Annfield, the proceeds of which together, would provide for more than double the amount of the sum required for taking in the new ground, even on the most extravagant plan that can be devised. This Mr. Rennie has omitted to notice. There is no doubt, therefore, that Mr. Chapman's plan, so far as absolutely required for the improvement of the present harbour, and for the purposes originally contemplated for the accommodation of the naval service, can be, in reality, executed for about half the sum which Mr. Rennie has stated.

Mr. Rennie next proceeds to say, that, as the shore deepens towards Newhaven and westward, the current becomes stronger and the bottom cleaner, and nature points out that the entrance should be extended in this direction, which would at once get rid of the Water of Leith, its bar, and deposit.

The case of Newhaven pier has proved how fallacious the idea of obtaining, or at least of preserving deep water by any extension in that direction is, and that any deposit from the river of Leith will be trifling compared to that which must take place by the erection of piers in a situation where there is neither back-water nor the full strength of the current of the Frith in operation to sweep it away.

The current at present runs with much greater velocity at the point proposed for the termination of the eastern pier than at Newhaven; but when the channel of the Frith, which, from the end of the present pier to Kinghorness is about 10,000 yards across, shall be contracted by nearly 1000 yards, by the extension of the pier, the effect of the cross current may be expected to be still more powerful.

The success of Mr. Chapman's plan in procuring an additional depth of water to a reasonable extent, and at a reasonable expense, is, therefore, a matter of certainty—while any corresponding advantage to be derived from the extension of the entrance to the westward, are problematical.

It appears, from an estimate given in to the Town Council in the year 1818, that the sum which would have been required to complete the docks on the original plan, was 322,000*l.* Mr. John Rennie now proposes, "That instead of executing the third great basin, according to the original plan, a ship canal, without quay walls, shall be made in that direction, with an entrance-lock near where the late Mr. Rennie proposed to make the cross wall, dividing the dock from the harbour; from thence a harbour to be made, carrying out the entrance into about 8 or 10 feet at low water of spring tides."

Mr. Rennie calculates the expense of this plan to be about 220,000*l.*; and for this, he observes, the grand object, depth of water and shelter, free access and departure at all times, would be obtained.

To obtain and to preserve the depth of water which Mr. Rennie states, the pier-head must be carried much farther out than either the original plan or that now brought forward by him, and, of course, a considerable additional expense be incurred,—and, even could this be accomplished, the vessels which may use this new entrance have to go through the tedious process of warping through a canal upwards of half a mile in length to arrive at the gates of the docks, while, in the case of the eastern entrance being improved, they could sail directly to or from the entrance of the docks. In theory, the warping such a distance, and passing several gates and bridges, may appear to be a slight inconvenience, but, in practice, it is very different.

When, at a very great expense, the city canal, which intersects the Isle of Dogs, was made, it was expected that a large portion of the shipping which went to the port of London would use it, to avoid the circuitous navigation round that island; but, in point of practice, the city canal is principally, if not entirely, used as a place for laying up shipping unemployed, or about to be exposed to sale.

The Committee apprehend, that this would be the principal use to which the proposed ship canal would be practically applied. The natural trade of the port of Leith, beyond its coasting and timber trade, lies with the different ports on the shores of the German Ocean and of the Baltic Sea; the size and draft of water of the vessels in that trade must, therefore, have reference not only to the port of Leith, but to the other ports on the opposite coasts which they frequent; hence the vessels are generally under 300 tons. In proof of which the following return of shipping, which entered the port in the year 1826, may be referred to:—

Number of Vessels which entered the port of Leith in the year 1826—

Under 50 tons	1402
Between 50 and 100 tons	1432
Between 100 and 200 tons	650
Between 200 and 300 tons	116
Between 300 and 400 tons	19
Above 400 tons	4

APPENDIX C.

LEITH.

No. 9.
Report of the Committee of the Inhabitants of Leith.

Mr. Rennie observes, that with the advantage of a good port, such as would be obtained by the measures above recommended by him, the trade of Leith might be carried to any extent, and the largest vessels now used in other ports would be accommodated here, and avoid all those delays and other inconveniences to which they are now subject, and which it is so anxiously desired by all to be removed.

The Committee are deeply impressed with the necessity of those delays and inconveniences being removed; but they are satisfied that this object can be attained to a great extent by Mr. Chapman's plan, not only by the additional depth of water to be gained thereby, but from the heavy swell, which in easterly winds endangers shipping so much at present, being almost entirely broken by the eastern pier.

The expression, "That trade may be carried to any extent," is but too frequently used by engineers unacquainted with the local trade and circumstances of the places to which their plans refer.

All the harbours and docks that could be constructed at the port of Leith would not make it an emporium for the East India trade, because the consumption of East India produce in the adjacent district of country is not sufficient to encourage its importation in large quantities at one time; and the same observation applies to the West India trade, unless carried on in ships of a moderate size.

But were it otherwise, and could the full advantages anticipated by Mr. Rennie be realized from his plan, it would be preposterous to expend 220,000*l.* for the accommodation of four or five ships of a particular class, while the port can be improved so as to answer all the purposes of its general trade at an expense of 50,000*l.*

The same remark is applicable to the idea, that a very complete dock-yard, upon a small scale, might be made, capable of repairing frigates, or even larger vessels upon an emergency. During the period when this country was engaged in war with nearly all the nations of Europe, there were rarely more than two frigates on the Leith station, while the number of vessels of a smaller class, and of revenue cruisers, was considerable. The Committee understand, that it was for this reason that, in the plan submitted to Lord Melville in the year 1824, the accommodation was proposed to be confined to vessels of 20 guns and under, from the conviction that his Lordship would never recommend the providing, at a greatly increased expense, for emergencies which might not once occur in the course of many years.

Unless, indeed, Government were to construct a wet dock as well as a dry dock at Annfield, communicating with the proposed works, vessels of war must lie in the ordinary thoroughfare of the ship canal, or of the present docks; while, by the plan already sanctioned by Act of Parliament, they are at once provided with a portion of the present wet docks, cut off from all communication with the merchant shipping.

Under all these circumstances, it is evident that Government, on full consideration of the matter, will never agree to advance any considerable sum for such a plan. As to the assistance which Mr. Rennie reckons on obtaining from the Ferry Trustees, to the extent of 30,000*l.*; this only shows, further, the inaccuracy of the local information on which he has proceeded. They have much more immediate demands upon their funds than to expend them in aid of such a plan.

The same observation applies to the city of Edinburgh, to whom the advancing of 28,000*l.* appears to be no very palatable measure—and certainly their raising or becoming bound for the payment of the interest of even one-half of the sum required by Mr. Rennie, is very unlikely.

The traders at the port are still less likely to allow themselves to be taxed for such a purpose, when, in consequence of existing arrangements, they have the Government pledged, and the Town Council of Edinburgh bound by statute to carry through a plan, which will answer all their general purposes, without adding to the heavy burdens already imposed on them.

In these circumstances, it appears to the Committee, that all further discussions as to Mr. Rennie's plan can have no effect, beyond that of retarding the execution of the other plans, which are already in a great measure provided for, and sanctioned by legislative enactment.

No. 10.
Telford, on improving the Harbour.

No. 10.

Report of THOMAS TELFORD, Esq., C.E., *on the Improvement of Leith Harbour.*

Edinburgh, June 26, 1828.

IN consequence of instructions contained in your several letters of the 8th and 25th of April and 5th of May last, I proceeded to the town of Leith and examined and compared the harbour works which have been already executed, and those which have been proposed, with the sundry documents with which I had been furnished.

Had it been found advisable to provide accommodation for vessels of great draft of water, the principal entrance should unquestionably have been made adjacent to Newhaven, as proposed by the late Mr. Rennie and Captain Huddart; but by the report of a committee of the inhabitants, dated 20th March, 1827, it appears that the vessels which entered the port in the course of the year 1826 were as follows:—

Under 50 tons	1402
Between 50 and 100 tons	1432
" 100 and 200 "	650
" 200 and 300 "	116
" 300 and 400 "	19
Above 400 tons	4

And by a statement furnished me by the Collector of the Customs it appears that, from the 2nd of October, 1826, to the 1st of October, 1827, the entries were—

3638	2116	small vessels without pilots.	
	1426	vessels drawing under	10 feet of water.
	96	vessels drawing	10 "
481	309	" "	10½ "
	172	" "	11½ feet to 12 feet of water.
122	67	" "	12½ " 13 "
	42	" "	13½ " 14 "
	11	" "	14½ " 15 "
	2	" "	15½ feet of water.

From the last statement it appears that from October, 1826, to October, 1827, out of 4241 vessels which entered the port of Leith, there were 3638 which did not exceed 10 feet draft of water, and other 488 which only required from 10 to 12 feet, leaving only 122 requiring from 13½ to 15 feet.

It is therefore evident that the nature of the business transacted at the port of Leith does not justify the incurring a great expense for the accommodation of vessels of large draft of water, and that any plan for an extension towards Newhaven for this purpose must be abandoned.

It is unfortunate that immediately opposite Leith the shore consists of a flat of sand to a very considerable distance outwards, and that, from the nature of the ebbing and flowing tides upon the adjacent coasts, which no effort of art can control, there is no prospect of this being materially changed. It therefore becomes necessary to consider what can be done to accommodate the port at an expense that is justifiable and by means that are safe and practicable.

From the best information I could procure the depth of water on the bar is about 15 feet at an ordinary spring-tide. I found the rise of the tide on the 31st of May to be 17 feet 4 inches, and by further observation I found neap tides at 3 feet 9 inches less rise than springs, leaving 11 feet 3 inches at ordinary neaps, and 13 feet 7 inches, when compared with such springs as I found. Therefore, if 2 feet more depth of water could be procured, by much the greatest number of vessels which frequent the port would be able to enter and depart with perfect safety at the top of all tides, and the largest at the high-water of springs.

Considering the great extent of flat sand which occupies the space between the harbour and the Mortella Tower, and from that place along the shore at Musselburgh, I consider that, even if the great expense which would unavoidably be incurred were wholly disregarded, the constructing solid piers to the extent required would be the means of an accumulation of sand, as in the case of Dublin and other places, which might increase instead of diminish the obstacles to a free entrance.

But as the present low weir, by directing the current of the river-water without obstructing the course of the tide, has evidently produced some effect, I recommend proceeding upon the same principle by constructing a range of beacons about 50 yards apart from each other in the direction of the above-mentioned low weir, and into a proper depth of water, without the Mortella Tower; and afterwards continuing a similar low weir, composed of furze and rubble-stone, with one board at bottom, between the beacons. By these means, and the occasional application of the dredging-machine, I am of opinion that an additional depth of 2 feet may be procured and maintained; and this would bring the bottom of the channel on a level with the top of the sill of the entrance-lock of the eastern dock.

But besides the shallowness of water at the entrance a serious inconvenience is experienced from its shape, which, being trumpet-mouthed, narrowing from the frith inwards, admits of an accumulation of water impelled by north-east winds, which renders the unprotected situation of vessels approaching or departing from the docks both difficult and dangerous.

In order to remedy this defect I recommend that a breakwater pier be constructed from the outer wall of the eastern dock to within 120 feet of the present pier-head, placed in the direction shown upon the accompanying map or plan. This would not only prove an effectual protection to the immediate entrance to the docks, but would form a convenient outer harbour.

The outer side of this pier should have a slope of 3 horizontal to 1 perpendicular, and should be paved with roughly-squared stone 2 feet deep on an average, without any pinnings. The interior packing may be common rubble-work, close packed, and the inside wall faced with well-squared stones laid in regular courses without any pinnings. The parapet should be at least 4 feet in breadth at the top, to afford access to the outer head, upon which a capstan should be placed. The parapet and capstan-pier should be built with well-squared ashlar stones of large dimensions: all these stones to be of a durable quality.

Along the inside of the breakwater an inclined slip should be constructed, to admit a double railroad of stone, which, by being connected with and worked by the steam-engine now in the dock-yard, might raise sand from the outer basin for ballasting ships.

The outer harbour may be still farther deepened by removing the sand, &c., and depositing it on the eastern side of the old pier, where, by building a rubble-stone wall parallel to the shore, much valuable ground may be formed and made applicable to useful purposes, and the mud which encumbers the old harbour, not being fit for ballast, should also be removed to the same place; the value of the ground acquired would defray the expense of the wall, &c.

After this western breakwater has been constructed the open space of the present old pier would of course be filled up, so as to prevent sand being brought into the outer harbour from the eastward, and, by constructing a proper tunnel from the eastern dock, to open within the breakwater, not only the outer harbour might be scoured by water from the docks, but the docks themselves might be emptied of mud and the entrance channel deepened.

The range of beacons would during the day be a sufficient direction for the vessels entering or proceeding outward along the eastern channel; but, to render it equally accessible by night, a small light should be placed on the south-east side of the root of the present pier, so as, when brought into a line with the light on the head of the present pier, would prove a safe direction for vessels during the night.

These several matters being accomplished, I propose deepening the channel from the outer bar through the outer harbour and up to the first drawbridge, to the level of the top of the entrance lock sill, for the breadth of 120 feet within the pier-heads, and for the same breadth to the extent of 1000 feet beyond them. This would not only form a free channel for the entrance and departure of vessels, but would admit an additional quantity of scouring water, which would have a tendency to preserve a proper depth.

What I have here recommended, with the addition of a tug-boat, would render Leith harbour as perfect as its localities admit of.

At Aberdeen a boat of this description has been employed for the last nine months, and has been found to answer a good purpose. Two engines, of 20-horse power each, prove quite sufficient. The total cost of boat and engines was 3000*l.*, raised by traders and shipowners, in shares of 10*l.* each; and, besides the facility it affords to the entrance and departure of vessels, it promises to prove advantageous as a speculation.

APPENDIX C.

LEITH.

No. 10.
Telford, on improving the Harbour.

The following is an estimate of the expense of performing the several works recommended in the foregoing report:—

	£.	s.	d.
Beacons and low weir	4,223	6	2
Breakwater and slip	13,070	12	0
Light on shore	1,000	0	0
Scouring tunnel from eastern dock	888	11	6
Deepening the outer and old harbour and entrance channel . .	1,709	4	0
	20,888	12	8
Contingencies 10 per cent.	2,088	17	3
	£22,977	9	11

To the Secretary of the Treasury. THOMAS TELFORD.

No. 11.

No. 11.
Cubitt, on improving the Harbour and Docks.

Report of WILLIAM CUBITT, Esq., *on the Harbour and Docks of Leith, and the projected new Harbours and Docks in its vicinity.*

SIR, 16, *Parliament Street, September* 11, 1834.

IN obedience to instructions with which I was provided on the 2nd ultimo, I proceeded to Leith on the 6th, for the purposes therein stated, and returned again to London on the 28th, since which time I have been engaged in preparing my Report on the following subjects, entrusted to my consideration, viz.: as to the present state of the harbour, docks, and piers at Leith, and the facilities for reaching them.

As to the best method of obtaining the deepest water for ingress and egress, whether by means of improving the present, or making another entrance, and the comparative advantages and expense of each of these methods; and to state the probable effects which the erection of new docks or harbours at Granton or Trinity may produce, if projected beyond high water line; together with any suggestions that may present themselves for making the present docks at Leith available for all the purposes contemplated by their erection, or the present wants of the port and neighbourhood.

In prosecuting this business, I not only examined the harbour, docks, and piers, with regard to depth of water, past and present facility of entrance, &c., as regards the engineering part of the concern, but took occasion to see and hear all the plans and propositions of various persons and parties interested in different ways upon the question, as well as to read the reports and opinions of many persons, engineers and others, touching the subject, a list of which I transmit in the Appendix to the Report.

For facilities as to acquiring information, plans, and documents of various kinds, my acknowledgments are due to the Lord Provost, Bailiffs, Town Clerk, Chamberlain, and Surveyor of Edinburgh, for access to many original surveys and plans of the harbour and docks of Leith, as also to the Clerk of the Leith Dock Commissioners, the Collector of the Shore Dues, and the Superintendent of the Harbour and Docks, for documents and information in their respective offices, which were tendered and communicated with the greatest readiness.

From the Admiralty Dock Commissioners (Captain Macvicar and Lieutenant Wentworth), I received much information as to the harbour, docks, and Government property; and Messrs. Crichton, Duncan, Philip, and other gentlemen of Leith, as Dock Commissioners and Merchants; and Messrs. Miller and Thomson, of the Town Council of Leith, furnished me with many facts and observations as to the state, prospects, and wants of the port.

As regards Granton Harbour, besides my own observations, I was supplied with plans on a large scale by Messrs. Gibson and Stevenson, the agent and engineer to the Duke of Buccleuch, as well as with information of a nautical kind relating thereto by Admiral Sir David Milne, and others. My attention was called to the Trinity Harbour scheme, by Mr. Scott of Trinity, with his engineers on the spot, and by subsequent plans and notes at great length.

The Manager of the London and Edinburgh Steam-Vessels (Mr. Hamilton), and Captain Bain, of the Monarch steam-ship, pointed out very strongly the necessity of better accommodation to the increased and still increasing steam-trade to the capital of Scotland. I also took a view of the ferry-stations on both sides of the Frith, in order to form a judgment as to how far any one plan for harbour accommodation might be made to combine the interests of all parties with the least possible detriment to any. Having by my own observations, aided by the above-stated means of information from parties in various and opposite interests, and the assistance of the plans and documents named in the Appendix, endeavoured to make myself master of the subject, I now beg leave to submit to your notice, for the information of the Lords Commissioners of the Admiralty, the following Report thereon.

The harbour of Leith is a tidal harbour, situated at the junction of the Leith water with the Frith of Forth. It was formerly encumbered with a bar at its mouth, and quite dry at low water, and is now very nearly so, but, owing to recent improvements, has a much better entrance of late.

A plan of this harbour, as it is represented to have existed about the year 1680, upwards of 150 years ago, is given in the sketch, No. 1,* (reduced from "Collins's Coasting Pilot,") and is curious as showing how little the form and extent of the low-water line is changed from that time to the present, as will be seen by comparing it with the sketch, No. 2,* reduced from a most excellent modern survey by Dall and Leslie, in 1831.

The water of Leith having formerly to make its way to the sea across the flat shore, dry at low water, called Leith Sands, the channel was subject to much fluctuation, according to the different direction of the wind and set of the tides, and the entrance of the harbour rendered both difficult and dangerous; to obviate which, in some measure, a pier of stone was erected a century back, about 100 yards long, in advance of the old wooden pier. This, in some degree, remedied the evil, but still left the entrance encumbered with a bar, shifting and unsafe.

From that time till about the year 1800 various surveys and reports were made, and plans proposed,

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* These plans will be found in Mr. Sinclair's office, City Chambers, Edinburgh.

APPENDIX C.

LEITH.

No. 17.
Cubitt, on improving the Harbour and Docks.

for the amelioration and improvement of the harbour, when the late Mr. Rennie had his attention called to the subject, and made a Report on the construction of docks and the improvement of the harbour; an extract only from which, relative to the state of the harbour, and the means of improving it, have I been able to obtain; but so accurate is the description therein given of the causes and affects relative to the entrance and the bar, and so perfectly have the statements and recommendations therein contained been borne out by subsequent surveys and recent experience, that I am induced to give the extract at full length in the Appendix (No. 1). The principal argument was, that no permanent and uniform depth of water would be obtained, and a shifting bar avoided; but by carrying a pier or weir on the east side of the channel quite across the sands to, or into, low water, by which means three, or possibly four, feet of additional water might be obtained; and that this effect has taken place in a proportion to the extent to which the works have been carried, my inquiries and observations tended to prove.

After Mr. Rennie's Report little or nothing was done with regard to the piers or entrance; but the present wet docks, warehouses, and graving docks were constructed, and other works performed, the cost of which, combined with other circumstances, precluded any further works during the life of Mr. Rennie.

In the year 1824 public attention was again called to the subject of the improvement of Leith Harbour, and the late Mr. W. Chapman, of Newcastle, made a Report thereon, with plans for the extension of the East Pier, and the construction of a west pier or breakwater to quiet the harbour, and form an outer harbour. Subsequently much correspondence passed on the subject of a naval and store-yard for the Government; the result of all which was that the Eastern Pier was extended about 1500 feet, on Mr. Chapman's general plan, a western pier and breakwater erected, and a portion of the western end of the Western Dock set apart as a store-yard for the naval service, the Government foregoing certain claims, to enable the city of Edinburgh to raise the necessary loan to complete the pier, which, with sums formerly advanced by the Treasury, for the construction of the docks, paying off bonds, &c., made in the whole 265,000*l.*, for the repayment of which, as I understand, the harbour and dock revenues are secured to the Government, relative to which, I have inserted one year's dock accounts in the Appendix (No. 2) as taken from the abstract statement of the affairs of the city of Edinburgh, in the year ending on Whitsunday, 1833.

Since the completion of the wet docks, the introduction of steam navigation, and its gradual extension and improvement, have made an entire change in the wants and uses of Leith as a harbour, and rendered necessary those kind of accommodations which, twenty or thirty years back, from not being wanted, were not provided for; for instance, Leith Docks, which are available for all classes of sailing-vessels which can enter the harbour, cannot, for want of a sufficiently wide entrance, be made use of by steamers. Steam-vessels, therefore, which carry goods in any quantity, and requiring to discharge at a wharf, must enter the harbour, and take the ground every tide (which for such vessels is very objectionable), as is the case with the Royal William and Royal Adelaide steam-ships, belonging to Messrs. Crichton and Co. of Leith, or must lie at anchor in the Frith, and load and unload their goods and passengers by means of boats in all weathers, which is at times both difficult and dangerous, and at all times disagreeable and expensive, but which is the plan pursued by the London and Edinburgh Steam Company, with their vessels the Monarch, Soho, and James Watt, which are not permitted to take the ground.

In order to facilitate the shipping and landing of passengers by the Fife and Mid Lothian Ferries, the numbers of whom very much increased with the introduction of steam-vessels, a stone pier was erected at Newhaven by an arrangement between the Ferry Trustees and the Government, and of which the London and Edinburgh Steam Company avail themselves for their use; but this is a very partial advantage, as the end of the pier being nearly dry at low water, the steam-vessels can rarely avail themselves of its use for lying alongside the pier to take in or discharge, consequently the whole of this great and important business has in effect to be transacted by those boats.

In order to facilitate also the great and increasing communication by steam to various places in the Frith of Forth, a chain pier has subsequently been erected about 500 yards to the westward of Newhaven Pier, which extends to 5 or 6 feet depth of water at low water, and serves for the use of the packet boats to Stirling, Queensferry, and various other places on the Frith, both above and below Leith; but this accommodation is very far short of what is required for the purposes of a good steam-packet accommodation.

The present form of Leith Harbour, and the relative situation of the above-described landing piers, are shown in the sketch, No. 2,* and also more at large in the printed map of Leith Harbour, by Messrs. Dall and Leslie, the accuracy of which I had many opportunities of proving.

The above is a general description of the state of the harbour, and of the quality of shipping accommodation at it, in the accounts of the port of Leith up to the present time, which it is agreed on all hands is far short of what is wanted; but no two parties agree in the propriety of what has been done, or what is proper to do, to remedy existing evils, on both which subjects the evidence and accounts of persons on the spot are of the most conflicting kind possible. I shall therefore briefly describe the works that have recently been done for the improvement of Leith Harbour, and their effects; and then state some of the principal projects which have been put forth for improving Leith Harbour and Docks, and for making new harbours in the vicinity.

The works last executed are, an extension of the Eastern Pier 1500 feet towards the Mortella Tower, and the erection of a breakwater to the westward, making an outer harbour of a triangular form, as shown in the plans; and in general executed agreeably to the report and plans of Mr. Chapman.

That this pier has produced a good effect I have no doubt; but whether the advantages obtained be equal to the cost (28,000*l.*) is by some disputed. From the best evidence I could obtain, and my own observations whilst on the spot, it appears to me that, by means of the new pier, and subsequent dredging, &c., an additional depth of 2½ feet† is obtained in the entrance to the harbour between the Mortella Tower and the dock entrance; and I have no doubt that if a low-water rubble-stone weir were continued from the end of the present pier round to the Mortella Tower, and the gaps between the tower and Beacon Rocks filled up in the same way as recommended by Mr. Dall, R.N., the present able and

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* These plans will be found in Mr. Sinclair's office, City Chambers, Edinburgh.

† If the 0 of the Old Pier gauge ever denoted the bar or bottom of the entrance at any one place, an additional depth of 3 feet 9 inches has been obtained.

APPENDIX C.

LEITH.

No. 11.
Cubitt, on improving the Harbour and Docks.

skilful Superintendent, so as to prevent the first third of the flood and the last third of the ebb from setting across the fairway of the entrance within and about the Mortella Tower, that a still greater depth would be obtained, and would be maintained, and the formation of a bar prevented, as by that means the strength of both the flood and ebb tides would be so much augmented outside the Black Rocks and the Mortella Tower, that no deposit would lie; and this, which is a very easy and economical thing to do ought, in my opinion, to be done, and a few warping buoys and dolphins put down, let what will take place with regard to the formation of other harbours or low water piers to the westward, and still the more even on those accounts if such should take place.

By stating that a greater depth of entrance may be obtained, and the formation of a bar prevented, I do not infer that Leith can be made a low water harbour (for that it never was, nor ever can be with its present entrance), but simply that a channel or fairway of entrance can be had, the bottom of which shall in all parts be at least 2 feet below the dock sill, and which formerly, before the erection of the pier, was at times more than 2 feet above it. At the time I was there, all parts of the entrance channel bottom were 1 foot lower than the dock sill.

Whatever may be done in the way of additional accommodation for steamers and large trading-vessels, at, or in the neighbourhood of Leith, there can be no doubt but that the great bulk of the shipping trade would continue to be carried on in the present harbour, and by the present entrance, especially when it is considered that the merchants themselves, their offices, warehouses, quays, and all other requisite accommodations are there fixed, and that the trade of the port is done by means of vessels, the average of the whole of which is under 80 tons; I believe nine-tenths of the whole under 100 tons; and that for vessels of any tonnage, with a draft of water within 11 to 16½ feet, the docks are available at all times, according to the height of the tide, which, in very low ebbs, flows 11 feet 3 inches above the dock sill, and in average spring tides 16 feet 9 inches upon it. Still it is asserted, that were there a harbour at Leith capable of receiving and floating at low water vessels of 12 feet draft of water, and accommodating steamers, much more and a different kind of trade would be induced to the port, which is now kept away solely by the alleged insufficiency of the harbour and docks.

With a view to obviate these difficulties, two plans have been recently brought before the public, one for a new harbour, or rather a set of docks at Trinity, about 500 yards west of Newhaven Pier, as proposed by Alexander Scott, Esq., and others, forming a joint stock company, and designed by Messrs. Grainger and Miller of Edinburgh, civil engineers (see annexed sketch, No. 3*); and the other at Granton, about one mile westward of the first, upon the estate of his Grace the Duke of Buccleuch, for a harbour and docks, with railway accommodation to Edinburgh and Leith, designed by Messrs. Robert and Alan Stevenson, civil engineers (see annexed sketch, No. 4,* reduced from Messrs. Stevenson's plans).

Now, without going into the merits of either of these plans, as plans, except so far as their being projected into the tide-way beyond low-water mark, may affect the present harbour and docks of Leith, and which, I am of opinion, would be very little, if at all, injuriously affected thereby, the question naturally arises as to whether the establishment of the Trinity Docks, or the Granton Harbour and Docks, will benefit either the public or the parties interested in their construction, in such a degree as to warrant their adoption of either plan, taking into consideration the effect that must be produced upon the existing establishments, trade, and income of Leith Harbour and Docks, if any part of the business were withdrawn into new and distinct channels.

Provided there were no harbour and docks at Leith, and if it were required under all the existing circumstances of improved intercourse between Edinburgh and London and all other places, to construct a harbour that should best answer every purpose, present and prospective, it would most probably be effected by enclosing a large piece of water with rubble-stone piers (as is done at Kingstown, near Dublin), in some situation between Cramond Island and Leith, where the water was clearest and deepest, nearest in shore, at the head of which docks, warehouses, and wharfs might be erected, and roads of communication formed with the capital and other places. Now, to cover the expense, and carry on an undertaking of this kind, would require at least the whole of the revenues at present derived from Leith Harbour and Docks at the recent high rate of charges on shipping, &c., supposing that such new establishments would cost about 400,000*l.*, and allowing 2000*l.* per annum only to keep them in repair, as is the case at Leith.

Of the two proposed new works, Trinity Docks is estimated at 250,000*l.*, and Granton Harbour at 268,000*l.*, but as neither of these sums includes warehouses, approaches, roads, railways, &c. which must of necessity form parts of establishments to be used for actual business, the sum of 300,000*l.* is as little as can be taken even on the estimates of the projectors themselves; and if the rates and dues on shipping and goods be so much too high at Leith, which is one of the arguments stated for wanting a new harbour, a reduction of 25 per cent. only would make it require more than all the present trade at Leith to pay simple interest on either of the proposed plans; so that I think it must follow, if any person lay out money sufficient to make any thing of an available and useful harbour either at Trinity or Granton, the money would be all or nearly all sunk as regarded themselves, the interest of the present harbour and docks injured, and the public in general very little if any benefited.

Still it cannot be denied that the shipping accommodations at Leith, as before observed are insufficient for present purposes, and that low-water floating accommodations for the large steamers, and the larger class of trading or foreign vessels up to 500 tons burthen at least, is very much needed, and ought to be had. The accommodation also for the roads from Mid-Lothian into Fife, and the north of Scotland, are also very deficient on both sides of the water, as regards the Ferries, which, although small vessels are obliged to embark and disembark their numerous passengers at low water by means of the ferry boats; and as regards the general steam packets up and down the Frith of Forth, the chain pier affords but a very insufficient accommodation in dark and blowing weather.

Having thus described the present state of the harbour, piers, and docks at Leith, and the proposed new works at Trinity and Granton, with their probable affects, it now becomes my duty to attend to that part of my instructions which relates to the suggestions of means for the improvement of the harbour and docks, which shall afford the greatest possible accommodation to all parties, with the least possible injury to any existing establishments.

After a very careful examination of the subject, I am of opinion that every requisite object may be obtained without rendering useless any thing which has previously been done for the improvement of Leith Harbour, with manifest improvement to the present docks, and that low-water floating accom-

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* These plans will be found at the Admiralty.

APPENDIX C.

LEITH

No. 11.
Cubitt, on improving the Harbour and Docks.

modations may be obtained in a safe and secure harbour, for all the steam vessels that come to the port, with a capability of embarking and disembarking their passengers and goods at a wharf alongside the public road, and be able to get to and from sea at all times of tide; and this at a very small expense compared with the objects to be obtained, and without any additional docks, ship canal, or lock work, save and except an entrance gate or lock at the western end of the present docks, as a communication with them.

To explain this, it will be necessary to refer to the sketches, Nos. 5 and 6, hereto annexed.* No. 5 shows the plan on a small scale as connected with the harbour and docks; and No. 6, the new low-water harbour on a larger scale.

The project is simply this. To include all the space between the western dock and Newhaven pier, with dry rubble stone breakwaters or piers, as shown in the plans. With an entrance between them at a depth of twelve feet, low water, spring tides, and within the space thus included, to excavate and dredge out a channel from twelve to fifteen feet deep below low water, and of sufficient width for the largest steam vessels to leave or pass. By this simple means will a harbour be formed, in which accommodation may be made for all the ferry packets and London trade, in the most economical manner possible, or which I suppose might be arranged somewhat in the manner following, viz.:—Newhaven Pier would answer all the original intended purpose, with the great additional advantage of having the steam ferries go alongside at all times of tide, perfectly sheltered in all weathers. A projecting pier (A) across the channel, at which two Frith of Forth steamers might lie at each side, and one across the end, would serve for all the general and short steam traffic. About 300 feet further east, a wharf (B) 300 feet long, at which two large steam boats would lie alongside, would serve for the London and Edinburgh Steam Company. and further up towards the docks might be one or more similar wharfs (C) for the use of the Leith and London steamers, or for large vessels, English or foreign, which might not enter the docks, or preparatory to entering the docks or sailing. At the upper end of the deep water channel I propose an entrance lock 60 feet wide, communicating with the western dock, getting access to the graving docks, and completing an entire communication with the present Leith harbour, as will be seen in the sketch No. 6. A plan of this kind would not only supply the desideratum of a low water harbour for steam vessels and foreign vessels of a greater burthen than can at present enter Leith Harbour, but would also render the present docks available for the same, and also for all classes of His Majesty's vessels that could be afloat in the docks, viz., from 16 to 17 feet draft of water; besides which, the Government property at Annfield, and at the western end of the docks, would become available for immediate use whenever circumstances might require it, as both would be made accessible at all time of tides from a quiet harbour. My estimate of the probable expense of carrying this work into effect is 125,000*l.*, according to the detailed statement in the appendix, No. 3, but even if it were to cost 150,000*l.*, I should deem its advantages cheaply purchased, compared with spending double the sum of money in the construction of new harbours, distinct from all present conveniences and works, which could only tend to the ruin of Leith Harbour and Docks; whereas, by making a deep water entrance connected therewith, the harbour and docks of Leith would be improved, the Government property and securities rendered more available and valuable, the road ferries and steam packet trade generally supplied with a good harbour and landing stations, all possible interests combined, and the city of Edinburgh furnished with a port suitable to all its wants, and commensurate with its increased and increasing magnitude and importance.

To the Secretary of the Admiralty. W. CUBITT.

(1.)

Extracts from a Report made by the late Mr. John Rennie, in the year 1799. [*See No.* 5].

THE harbour of Leith in its present state labours under many disadvantages, besides those peculiar to dry or tide harbours: it is much too small, and the water is too shallow for the present extensive and increasing trade; the vessels upon the breaking up of the sea frequently sustain great damage, and even some in heavy floods, which are frequent in this river.

The harbour of Leith has, in common with all river harbours, its bar, which appears by Mr. Ainslie's map to be about 200 yards distant from the point of the east pier, and which varies in distance and depth according to the quantity of water sent down by the river, the direction and extent of the winds, and height of the tide. The bar is formed at the place where the waters of the river and tide become equal in force to each other, and create a stagnation, during which they deposit the silt they contain, and form a and bank. Again,

The harbour of Leith is formed and kept open by the small river which passes through it to the sea, and like all such harbours is liable to considerable variation in depth, according to the wetness or dryness of the seasons; for when the season is wet there being proportionally a great quantity of water in the river, it scours the bottom deeper, and has considerable influence in reducing the bar, and deepening the channel towards the tide streams of the Frith of Forth, and *vice versâ;* but there is a certain point to which this depth can come and no farther (unless an additional quantity can be brought into it), this depth depends upon the tenacity of the clay or sand, area of the sections, and obstructions the water meets with from the shipping. In a river whose quantity of water is given, the depth will be nearly inversely as the width; this being admitted, we must look for accommodation elsewhere than in the channel of the water of Leith.

For these reasons it appears to me that the improvement of the present harbour should be confined to the making of good quay walls, cutting off projecting and inconvenient places, advancing them forward when the regular sweep requires, and digging the bed of the river and harbour to a uniform depth, which the toughness of the till prevents the river from doing, and scouring away the mud by loosening it in floods, and in general assisting the means which nature has afforded of putting and keeping in as good a state of repair as it will admit of. But farther than this it ought not to be done for a dry harbour.

There is now 10 feet of water at good spring tides nearly as high as Leith Mills, and about 12 to 13 feet at the Old Bridge, and eighteen inches or two feet more might be made and preserved; but this will, in a certain degree, depend on the depth to be made on the bar, about which I shall afterwards say something.

The sand-banks commencing to the eastward of Newhaven, and continuing in that direction beyond the entrance of Leith Harbour, are varied and enlarged by the north and north-east winds, the former

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* These plans will be found at the Admiralty.

APPENDIX C.

LEITH.

No. 11.
Cubitt, on improving the Harbour and Docks.

meeting the river and returning tide directly in the face, and the latter bringing sand from the eastward through the opening between the Beacon Rocks and the Black Rocks. Had this latter chain been continued, the bar or entrance would have been more sheltered, and of course it would have suffered less from that quarter. Nothing therefore very great in the way of deepening can be done,—the best means of effecting this would be to extend the east pier seawards, but this would be attended with very great expense.

The idea that has been suggested of narrowing the mouth, would I apprehend be attended with little benefit, for although it would certainly deepen the channel where the contraction is made, and perhaps a short way up the harbour, yet as soon as it gets beyond that mouth it would be obstructed by the sea, as it now is, and although by continuing the backwater undivided to some further distance, yet it would only drive the bar a little further to seaward without materially increasing its depth. The fact is the tide ebbs too far beyond the point of the pier; and it is useless to deepen the mouth of the harbour while between it and the sea is a shallow bar.

In a former part of the Report, I have given it as my opinion that unless the East Pier is very much extended, no great additional depth of water can be obtained at the entrance of the harbour, which is also of much consequence to the trade of Leith. The expense of extending the pier would be very great, and when so done, I do not apprehend that more than three, or at most four feet additional depth of water could be got. A question therefore arises whether it would not be better to look out for another entrance with more depth of water, and where the depth could be maintained at a reasonable expense, than to be at the expense of lengthening the East Pier.

(2.)

Statement of Produce of the Leith Dock Estate in the Year ending Whitsunday 1833, *taken from the Abstract Statement of the Affairs of the City of Edinburgh, September*, 1833.

				£.	s.	d.
Dock dues received				6,693	19	11
Feu duties, rents of ship yards, &c.				2,899	7	1½
Together				£9,593	7	0½
Deduct expense of repairs, dredging, &c., by Commissioners, public burdens and charges of collection for collector's account, subject to audit of Commissioners				2,552	16	4½
Net produce				7,040	10	8
The debts with which the dock revenue is at present burdened, consist of—						
1st, Bond to Barons of Exchequer, 4th December, 1805, for				25,000	0	0
2nd, Ditto ditto, 4th July, 1827	240,000	0	0			
Of which there has been liquidated by Sinking Fund, established by Dock Acts of 1825 and 1826	19,007	5	0			
				220,992	15	0
Amount, with interest resting from 1st March, 1833				£245,992	15	0
Interest on the above bonds for one year at 3 per cent., the rate presently payable to Government, is				7,379	15	3
And taking the above sum of net receipts as the produce of the dock revenue				7,040	10	8
There appears an annual deficiency for the payment of interest, of				£339	5	0

But in terms of the arrangement with Government in 1826, there falls to be paid annually, besides the interest, a sum to account of the Sinking Fund then established for the redemption of the principal in the following manner:—

	£.	s.	d.
1st, Interest at 3 per cent. on bond of 25,000*l.*	750	0	0
2nd, Four per cent. on 240,000*l.*, the excess of which above 3 per cent. on the part thereof remaining due, is applied in payment and extinction of the principal	9,600	0	0
Together	£10,350	0	0
Taking as the average the produce of the dock revenue as before	7,040	10	8
Remains as annual short-coming to be supplied	3,309	9	4

Under the arrangements of 1826 however, the sums payable on account of the bonds of 240,000*l.* falls to be increased in the year 1829 from 4 to 5 per cent., to be applied, in the manner already stated, in extinction of the principal. The 4 per cent. is payable for 12 years, from the 5th July, 1827, on account of the city having advanced 28,000*l.* on the extension of the pier.

Statement of the Revenue of the Harbour and Docks of Leith for Five Years, from 1829 *to* 1833, *both inclusive, viz.*—

Shore Dues Office, Leith, August 11, 1834.

	1829.			1830.			1831.			1832.			1833.		
	£	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
Feus, rents, &c.	2,656	8	1½	2,589	6	8	2,983	8	8½	2,987	3	7½	2,927	15	2
Dock dues on shipping	5,685	11	1½	7,072	6	11	7,208	15	7	6,662	1	6	6,691	8	6
Harbour dues on do.	2,616	11	7½	2,433	18	0	2,541	2	1½	2,899	14	5½	2,413	1	1
Shore dues on goods	5,014	1	6	4,593	2	6	4,859	8	10	4,610	4	10½	4,633	18	8
Merk per ton on do.	3,876	12	1½	3,616	2	7	3,797	3	6	3,414	18	6½	3,180	11	3
Pontage on ditto	1,009	19	6½	1,242	9	8	1,285	2	11½	1,252	10	11	1,182	17	8½
Prime gilt on ditto	918	4	7½	812	14	3	938	1	6	845	6	5½	753	5	11½
	21,777	8	8	22,360	0	7½	23,613	2	9½	22,172	0	4½	21,782	18	4

Average of the five years 22,341*l.* 2*s.* 2*d.* Mr. Sandeman begs leave to present his compliments to Mr. Cubitt with the above statement according to his request, and hopes it will prove satisfactory.

APPENDIX C.

LEITH.

No. 11.
Cubitt, on improving the Harbour and Docks.

(3.)

Detailed Estimate of enclosing and excavating a New Western Harbour at Leith.

Length of East breakwater, 3200 feet.
Ditto of West ditto, 1200 feet.
2000 × 31 × 7 = 434,000 of rubble in basis of East pier, 1st length.
2000 × 100 × 3 = 600,000 ——— in facing slopes and top.
1200 × 58 × 13 = 904,800 ——— in basis of East pier, outer length.
1200 × 100 × 3 = 360,000 ——— in facing of slopes to ditto.

Total 2,798,800 ——— in East breakwater.
904 × 800 × 360,000 = 1,264,800 ——— in West ditto.

Total 4,063,600 cube feet in both breakwaters.

Allowing 20 cube feet of rubble work to be one ton, the number of tons will be $\frac{4{,}063{,}600}{20} = 203{,}180$ tons of stone.

	£	s.	d.
203,180 tons of rubble stone rough packed in basis and laid in slopes, at 4*s*.	40,636	0	0
Add contingencies, 10 per cent.	4,063	0	0
Total of breakwater	£44,699	0	0

Estimate of a Cut, or Deep-water Channel, in Two Parts, viz.—

	£	s.	d.
1st. Entrance channel 1500 feet long, 150 feet wide at the bottom, with slopes 3 to 1; 10 feet of stuff to be dredged out at one end, and 2 feet at the other—56,880 cube yards at 1*s*.	2,344	0	0
2nd. The main cut or harbour channel, 3000 feet long, 200 feet wide at bottom, slopes 2 to 1 on the quay side, and 3 to 1 on the off side, excavated and dredged at an average 13 feet deep, so as to have 12 to 15 feet depth at low water will contain 453,000 cube yards, which at 1*s*. per yard	22,650	0	0
	£24,994	0	0
Add contingencies 10 per cent.	2,499	0	0
Total dredging and excavation	£27,493	0	0

Note. The clay and earth excavated and dredged is reckoned at such a price as will lay it in the nucleus of piers, or at the back of the land slopes; or deposit it wherever it be wanted.

Estimate of forming a Rubble Slope on the Land Side to form a Road in front of Anchorfield and Annfield, to connect Leith with Newhaven, by the side of the Harbour.

	£	s.	d.
Slope 3000 feet long, 1½ to 1·36 feet wide, and stoned 2 feet thick will be 12,000 square yards area, which at 5*s*. the square yard for all labour and materials, is	3,000	0	0
Add 10 per cent. for contingencies	300	0	0
Total, forming and stoning slope	£3,300	0	0

Road making, &c.

	£	s.	d.
Forming road along the shore in front of Anchorfield and Annfield, and in front of new wharfs, &c., say 1000 yards at 20*s*.	1,000	0	0
Contingencies of compensation, fencing, &c.	1,000	0	0
Total, roads, &c.	£2,000	0	0

Wharfs, &c.

	£	s.	d.
Adding and securing Newhaven Pier so as to land and ship at low water	1,000	0	0
One new wharf for Forth steamers. One new wharf for London steamers. One new wharf for other purposes. Each wharf to contain 10,000 feet of timber, coppered or scupper nailed in the water, driven, bolted, secured, complete in place, all labour and ironwork included, at 6*s*. per foot will be £3,000 each wharf, or for the three	9,000	0	0
Total of wharfs	£10,000	0	0

Summary of Estimate.

	£	s.	d.
1st, Breakwater as per details	£44,699	0	0
2nd, Excavating and dredging per details	27,493	0	0
3rd, Forming and stoning land slope	3,300	0	0
4th, Road making, &c.	2,000	0	0
5th, Wharfs	10,000	0	0
6th, Junction lock with dock	21,000	0	0
7th, Dredging machine, implements and contingencies thereon	16,508	0	0
	£125,000	0	0

W. CUBITT.

To the Secretary of the Admiralty.

APPENDIX C.

LEITH.

No. 12.

Anderson, on the state of the Harbour.

No. 12.

Report of JAMES ANDERSON, Esq., *Civil Engineer, on the present state of Leith Harbour, and the practicability of rendering available its Wet Docks, by means of a Deep-water Entrance at Newhaven, and a communicating Dock or Ship-canal.*

SIR, *November* 20, 1834.

IT is matter of public notoriety, that the port of Leith, with its excellent wet docks, which are of the best construction, and upon which so much has been expended, can never, from its present entrance, be more than merely a tidal harbour. The situation of the pier, and natural causes, combine to preclude the possibility of its ever being made a low-water harbour by the present channel. It may indeed be possible, at an enormous expense, to extend the pier seaward to the deep channel of the Forth; but no artificial means can overcome the natural obstacles, either by deepening the channel of the River Leith along the pier, or keeping its course free. The immense shoal of sand, which extends over a space of nearly five miles, from Newhaven pier to the east of Portobello, and reaches seaward beyond the Mortella Tower, is continually shifting, and would soon fill up any excavation of the channel of the River Leith. That river itself, besides, in time of floods, continually brings down a great quantity of alluvial soil, which accumulates, and is deposited at its junction with the waters of the Frith; thus forming a bar across the channel and fairway of the harbour, which it is impossible for any works of art to prevent or remove.

But suppose that even a cauld and reservoir were constructed immediately above the harbour, which the situation of Leith mills prevents; or, were they even formed higher up the river at its source beyond all the mills, with the view of containing a large body of water, occasionally to clear out the channel at low water; yet this measure would be ineffectual, as it would only tend to remove the bar a little farther seaward, without increasing the depth of the channel; for the bar will always form at the place where the influence or force of the river and tide becomes equal, thereby causing a stagnation and depositation of the silt which is mixed with their waters.

The late Mr. Rennie was quite aware of the disadvantages under which the port of Leith laboured from its present entrance, and of the great benefit likely to result were a proper western entrance obtained. Indeed, in one of his early reports on Leith Harbour, after mentioning that there is, at the old drawbridge, about 12 or 13 feet water at spring-tides, he says, "The sand-banks commencing to the eastward of Newhaven, and continuing in that direction beyond the entrance of Leith Harbour, are varied and enlarged by the north and north-east winds, the former meeting the river and returning tide directly in the face, and the latter bringing sand from the eastward through the opening between the Bencon Rocks and the Black Rocks. Had this latter chain been continued, the bar or entrance would have been more sheltered, and of course it would have suffered less from that quarter. Nothing, therefore, very great in the way of deepening can be done. The best way of effecting this would be to extend the pier seawards; but this would be attended *with very great expense.*" And again, he says, in regard to a certain operation for deepening the channel, "It would only drive the bar farther seaward, without materially increasing its depth. The fact is, the tide ebbs too far beyond the point of the pier; and it is useless to deepen the mouth of the harbour, while between it and the sea is a shallow bar. The expense of extending the pier would be very great; and, when so done, I do not apprehend that more than 3 feet, or at most 4 feet additional depth of water could be got at. A question therefore arises, whether it would not be better to look out for another entrance with more depth of water, and where the depth could be maintained at a reasonable expense, than to be at the expense of lengthening the east pier." Mr. Chapman, again, in whose opinion touching these imperfections I thoroughly concurred, seemed to me to have exercised all his ingenuity without the possibility of any other than very transient benefit. Nothing could be more evident to me indeed than the certainty of continued defect and irremediable loss, whatever expense or labour was elsewhere directed, should an addition of this kind be withheld. No less clear was my conviction, that, were money laid out to any attainable amount whatever in improvements of a similar description, or in the same quarter, the necessity for more would perpetually recur, while the good realized as perpetually vanished.*

This admitted condition of Leith Harbour is more than ever to be regretted, steam navigation having become of such vast importance that it may justly be called the main-spring of commerce, while it is pre-eminently superior to every other mode of transit. It is a fact, notwithstanding, that, except at very high tides, seldom or never can any of the steam-ships enter this the port of the capital of Scotland. Indeed, the greater number of the steam-vessels in the London trade, and frequently those employed in the ferries, and otherwise in the navigation of the Forth, are obliged to cast anchor at a great distance off shore; and in that situation, by means of small open boats in all weathers, embark and disembark passengers, to their great annoyance and danger, besides having to ship and reland heavy goods and luggage, which is both difficult and expensive, and, as occasionally happens during stormy weather, cut off from all communication with the shore.

Immediate and ample accommodation for the steam-trade is therefore imperiously called for, in order to prevent its being transferred to other ports, whereby not only Leith would be entirely ruined, but the interests which both Government and the City of Edinburgh hold in the harbour and docks, would for ever be lost, as assuredly will be the case, should accommodation be provided for the trade elsewhere.

The main object of my plan and of this report, is to supply an adequate remedy for such existing and threatened evils; in other words, it is, in the first place, to improve the port of Leith itself, by giving it a deep-water entrance from Newhaven, and thereby converting it into a low-water harbour. Secondly, it is to afford accommodation for steam-vessels and the trade in general, by admitting foreign and other vessels of greater burden than have hitherto entered the port of Leith. Thirdly, It is to supply suitable provision for the Fife and Mid-Lothian ferries, which is very deficient on both sides of the Forth. And, lastly, to give shelter at all times to all classes of His Majesty's navy, and which no plan hitherto proposed for the improvement of Leith Harbour could afford.

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* Since so much has been done, by no means with commensurate benefit, for the present entrance to Leith Harbour, which, I am well aware, will and must be used by a considerable number of the vessels trading to the port, I am of opinion there would be some justice in extending the *Weir* to the Mortella Tower, with a view to confining both the flowing and receding tides to the fairway of the channel. This, however, ought to be effected at the least possible expense, as, after all, it can be considered no other than a minor expedient, absolutely incapable of fulfilling the purpose contemplated in a great harbour. It would indubitably render the present works more available than they now are or can be without such addition.

I shall now speak of the advantages of the situation of the proposed works. The shore immediately to the west of Newhaven Pier is superior, and pre-eminently better adapted for a low-water pier than any other spot in the vicinity of the port of Leith, there being not only the necessary depth of water closer in shore, but the channel, which consists of a hard blue clay, being free of all foul ground and sand-banks, consequently affording an excellent foundation for the construction of sea-works. At 300 yards west of the line of Newhaven Pier, and 400 yards seaward of low-water mark, 10 feet depth of water is found at the lowest ebb of stream-tides; whereas in the direct line of Newhaven Pier, where the ground is both rocky and foul, the same depth of water cannot be found nearer than 600 feet farther seaward, or 600 yards from low-water mark. Farther to the eastward, the distance at which 10 feet depth of water can be obtained, is still greater. About 300 yards to the east of the line of Newhaven Pier, and nearly opposite the seaward termination of Mr. Cubitt's proposed works, the distance is 650 yards; and 300 yards still farther to the east, the distance is not less than 800 yards. In short, the whole space betwixt Newhaven Pier and the Mortella Tower, consists of shallow ground and sand-banks, while the foundation of the tower itself is actually quite dry at low water of stream-tides.

Most evidently and decidedly, therefore, any works either in the line of Newhaven Pier or other place to the eastward thereof, intended for the improvement of Leith Harbour, whatever may be their construction, would be of minor utility; and, most assuredly, any money expended thereon could never be productive of corresponding and permanent benefit.

It is generally understood that the late Mr. Rennie considered his having placed Newhaven Pier in its present site as a failure, the ground being shallow, rocky, and foul beyond its termination. I have delineated the western entrance proposed by him on the annexed plan; from which it will be seen that he did not intend to convert Leith Harbour into a low-water harbour, but only to obtain a few feet of more depth at high water than the present entrance could afford; and indeed the objection generally made to his proposal was his having placed the entrance to the east of Newhaven Pier, instead of to the west.

The plan by Mr. Cubitt is founded on the same principle as the one suggested by me in April last, and now treated of in this report, namely, to afford Leith "a deep entrance at low water of stream-tides," by means of carrying piers and breakwaters into the deep channel, so far as this can be accomplished.

I choose for the site of my entrance a portion of the channel about 300 yards to the west of the line of Newhaven Pier, for the best of reasons, namely, both on account of deep water being nearer the shore, and the channel free from all foul ground. The pier and breakwater I propose to be of substantial stone work, filled up with stone packing; and my channel or communication along the line of the beach to the wet docks of Leith is intended to be a Wet Dock or Ship Canal 200 feet wide, with flood-gates, substantial sea-defences, and a stone quay along the whole extent. This canal would contain 30 feet depth of water, at the height of spring-tides, and this depth, which could also be had at low water by simply shutting the flood-gates, would be sufficient to float any of his Majesty's Navy. Mr. Cubitt, on the other hand, fixes for the site of his entrance on a portion of the channel at nearly a correspondent distance east of the line of Newhaven Pier: he describes his work thus:—"The project is simply this. To include all the space between the western dock and Newhaven Pier, with dry rubble stone breakwaters or piers, as shown in the plans, with an entrance between them at a depth of 12 *feet low-water spring-tides*, and within the space thus included, to excavate and dredge out a channel from 12 to 15 feet deep below low water." He describes his communication or main channel along the beach to be also 200 feet wide, but open, sloped, and cased with stone on the land side, on which he proposes to erect wooden wharfs; and, consequently, it would only be at high water that the necessary depth could be had in his channels. Now, to find at his entrance a depth of 12 *feet at low water of spring-tides* is completely out of the question, for the seaward termination of his western breakwater is distant about 700 feet from even 10 feet, and not less than 1700 feet distant from where 12 feet depth can be found at low water of spring tides. (See the lines of 10 and 12 feet soundings on the plan; and, for farther confirmation of these remarks, I refer to Messrs. Dall and Leslie's chart.)

Again, Mr. Cubitt's breakwaters, from the manner in which he proposes to construct them, and fill up their nuclei with the clay or material excavated out of his channels, I have no hesitation in pronouncing to be impracticable; and I am confirmed in this opinion, not only by my own experience and observations in regard to various sea-works, but by all other professional and practical men with whom I have conversed on the subject.

In the preliminary part of this report, I have already alluded to the various opportunities I have had in making observations on the tides, winds, and currents, as well as the soundings in this quarter of the Frith; and my attention was particularly directed to the investigation of these points upon one of the occasions mentioned, namely, at the time I planned the sea-works for the approach to Newhaven Pier in 1824, and which arose from the following circumstance.

On taking the various levels in order to connect that work with the pier, I found that at 200 feet north of the shore or landward end, the channel on the eastern side of the pier was 3 feet above the level of that on the opposite or western side. This difference of level must evidently have been caused by the action of the sea, notwithstanding the square head of the pier, which, from its peculiar form, would to an observer appear rather to encourage the lodgment of silt, and filling up of the channel, than to admit either of its being deepened or of the hard substance washing away. Upon investigation, I found that this part of the pier had originally been founded 3 feet under the surface of the channel into the hard clay, but, by the continued action of the receding tide, the channel had been deepened, and the stone foundation of the pier for 100 feet in length was actually undermined, and considerably above the level of the channel. In consequence of this the foundation had to be underbuilt.

The result of my observations was, that on account of the position of the promontory of North Berwick, the bulk of the waters at the mouth of the Frith is influenced so as to be directed to wash more in upon the northern than the southern side of the Forth; and consequently, the making or flowing tide sets in very close along the north shore, more especially at Kingborn-ness, and along to the promontory west of Aberdour, and north of Inchcolm; the current thence flows in a south-westerly

Appendix C.

Leith.

No. 12.
Anderson, on the state of the Harbour.

direction through the gut betwixt Inchgarvie and North Queensferry.* In like manner, the breadth of waters in Inverkeithing Bay, and to the westward, is influenced by the projecting promontory of North Queensferry, which causes the receding tide to rush through the strait or gut already mentioned, directing the bulk of the current to pass through betwixt Cramond and Mickery Islands,—thence setting in close upon the south shore at Granton and along to Newhaven Pier, upon which it strikes with considerable force; and the current has consequently not only deepened the channel immediately on the western side of the pier, but farther out, at the site of the termination of the proposed pier, where deep water is found nearest the shore. The current of the tide, being thus intercepted by Newhaven Pier, and the Bush rocks and rocky ground immediately to the north of the pier, runs in a north-easterly course in the direction of Inchkeith, on the north of which island the bulk of the current flows. It appears therefore, that, betwixt the rocky ground north of Newhaven Pier to the Mortella Tower, the whole space within that line and the shore is formed into an eddy, which is partly the cause of the sandbanks, and the continuance of which must necessarily render effectual improvement in that situation absolutely impossible. The course of the current at Newhaven Pier will be better understood by looking at the dotted lines of 10 and 12 feet soundings on the plan.

The position and construction of my proposed pier and breakwater are such as would shelter the harbour not only from the prevailing east and north-east winds, and the swell of the waters from the German ocean, but also from the western gales. A vessel, for instance, driving before an east wind, could swing round and fall into the lee, on the western side of the pier, which projects about 600 feet beyond the head of the breakwater; and in a westerly gale, the course would be quite clear, for no vessel making her way to the harbour could possibly escape its entrance. But in gales from the east or west, or indeed from any point of the compass, vessels could never find admission into a harbour, the entrance to which was in the form of a bottle mouth (such as Mr. Cubitt's). The breakwater, while it would afford shelter from the westerly gales, is so constructed by having a clear arched water-way of 200 feet through it, that the receding tide which has been already described as setting close in along the southern shore, would not be obstructed, but would, along with the breadth of water contained in the harbour, rush out at the entrance channel, thereby officiating as a self-acting agent, and preventing the lodgment of sand or silt. The head of water which the proposed canal or wet dock would contain, viz., 20 feet above low water of spring-tides, could also be employed to clear out the channel if necessary, by opening the flood-gates an hour before low water, so that there would be no difficulty in keeping the channel clear, without the aid of dredging machines or otherwise.

General Description of the Proposed Works.

It will have been observed, from my letter addressed to the Honourable Commissioners for the affairs of the City of Edinburgh, that the works exhibited on the finished plan, which I had prepared immediately after the sketch, plan, and report had been submitted to them in April, were greatly simplified; and that my estimate was consequently considerably reduced.

The pier which I propose to be 60 feet in breadth, and the outer walls of hewn stone of peculiar construction, secured with cast and malleable iron-work, &c., runs out into the channel from the western point or head of Newhaven Pier, 35 degrees west of north, to 10 feet depth of water at the lowest ebb of spring-tides. The depth is found here at 400 yards seaward of low watermark. The pier on the western side of its defence-wall, is intended for high water, and the eastern side for low water; and the pier-head ought to be surmounted with a lighthouse for the purpose of guiding vessels into the harbour. The breakwater again, from a point at high-water mark, nearly 500 yards west of Newhaven Pier, runs out one point east of north to the site of its head, which is also to be built of hewn stone, and to terminate at a point about 200 yards within the head of the pier, leaving an entrance-channel of 200 feet in width. This channel I propose to excavate 10 feet below low-water spring-tides, or on a level with the site of the pier-head. The breakwater is to be cased with stone on end, having an arched water-way of 200 feet through it, for the receding tide to pass, as already referred to; and the interiors or nuclei, of both the pier and breakwater are to be filled up with stone packing.

I may here add, that this portion of the proposed works, the expense of which is estimated at 63,138*l.* 6*s.* 6*d.* sterling, but say with contingencies, &c. &c., 70,000*l.*, might, if considered advisable, be executed in the mean time, (exclusively of the sea-lock, flood-gates, ship-canal, and other works to the eastward,) and would form a floating harbour for steam-vessels, by excavating the remainder of the channel betwixt the proposed entrance and breakwater; and, while it would give immediate accommodation to the steam trade, the latter portion of the works could be executed at a future period. But I do by no means recommend this delay, and merely throw out the hint in the event of there being difficulty in obtaining money for the whole works; as I would decidedly advise the whole to be done at the same time, for many considerations, namely, 1st. In point of economy; 2nd. In justice to the works themselves, that they may not be broken up and disturbed after being completed; and 3rd., because the simultaneous entire completion of them would be of essential importance to the trade and port of Leith.

The connection between the pier and wet dock or ship canal is by means of a sea-lock, 170 feet long by 60 feet broad, and the flood-gates of which can be kept open or shut at pleasure. I propose the wet dock or ship-canal to be 200 feet wide at top, and the channel 150 feet, and excavated 10 feet below low water of stream-tides, or on a level with the entrance channel. The land-side is to have a wharf or quay stone-wall, built of large square rubble, hammer-dressed, scarped, and nidged; and the bank on the off side to be sloped and defended from the wash of the water, partly by a dwarf retaining-wall, and partly by stone casing, with a breadth of banking 100 feet at top, betwixt the canal and sea defences.

For these defences, I propose a bulwark and sea wall, on the same principle as that adopted in the work which I designed and executed for the proprietor of Wardie, namely, to excavate the channel to such a depth as that the top of the bulwark foundation-stones, which I propose to be of considerable length, and placed in a vertical position, shall be below the level of low water-mark,—the surface of the bulwark forming an inverted or catanarian arch, with the stones all placed vertically on end. Betwixt the canal bank and bulwark, I propose to erect a strong rough dry rubble stone-wall, and the void betwixt and under the bulwark to be made up with dry stone packing,—the

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* See my report and design for a suspension bridge at Queensferry, published in 1818, the surveys, soundings, &c., &c., pertaining to which were taken in the preceding year.

No. 12.
Anderson, on the state of the Harbour.

whole to be connected as shown in the section, and surmounted with a wall of large sized square rubble in courses, hammer-dressed, scarped, and ridged, and covered with a broad deep stone-coping.* This form and construction of bulwark is, in my judgment, better adapted for a sea defence than any other form hitherto devised. The concavity of its surface is more in accordance with the sweep of the natural channel than either a convex or straight surface can be. It gives less resistance to the waves, while it becomes more secure in proportion to the weight by which it is surmounted,—provided all voids below are made hard up and sufficient. These defences, which for such and other reasons, I prefer to a hewn stone-wall, can be executed at very moderate expense. The proposed entrance to the western wet dock I also intend to be 60 feet in width, so that the largest steam ships may enter. The entrance to the dock is to have also a flood-gate, for the purpose of confining the water therein, when the sea flood-gates are opened in order to the clearing out the channel, or otherwise. This will make the communication with the harbour of Leith entirely complete. I also propose to form a roadway from Newhaven along the line of the wharf or quay wall to the Leith Docks and warehouses.

The cost of the whole of these works I estimate at 124,695*l.* 11*s.* sterling.

This amount, although considerable, is not at all to be compared with the vast importance of the measure, and the advantages that will necessarily arise from it; and, if I might be permitted to express an opinion, I would say that were the plan I propose carried into effect, it would render Leith from being one of the worst, one of the best harbours in Great Britain.

The site selected for it could not be better in point of access, the principal part of the works being in the direction, and at the very commencement, of the new approach to Edinburgh, which, when completed, will not only be the nearest, but the most level, and consequently the best, line of road to the city; while, if a corresponding provision were made on the north shore for the Fife and Mid-Lothian ferries, it would not only be a great boon conferred on the north of Scotland, but likewise considerably enhance the property in the county of Fife, which would have thus, at all times, a ready communication with the capital.

I need hardly remark, in addition, that the Government and private property, lying in the immediate vicinity of the projected works, would be materially improved in value.

In regard to the time required for completion, my impression is, that were the works begun early next spring, they might be finished in the autumn of 1836,—two summers being sufficient for the purpose.

Such, then, are my views and sentiments regarding the mode of connecting the port of Leith with an entrance from the west. Should they not be carried substantially into effect, I have not a doubt that a rival harbour will be provided elsewhere—and in my judgment, the site of this will, most probably, be Granton, as, among other reasons, it is free from the shore-dues exacted by Edinburgh. On the other hand, if the works now proposed were immediately carried into effect, the advantages both to the city of Edinburgh and to Leith would be incalculable. In reality, I am of opinion, that, were a modification of its existing rights conceded, the former would eventually be retrieved from embarrassments, while the latter would soon rank among the first commercial ports of the empire.

JAMES ANDERSON.

Edinburgh. 6th Nov., 1834.

HAVING observed, after the completion of the annexed estimate, that the expense of the carriage of stone was actually greater than that of the material itself, I considered it advisable to address the following letter to Mr. Johnston, Craigleith Quarry (who had previously furnished me with the data upon which I founded my prices of the masonry), with a view to ascertain the saving which might be effected by the mode suggested. His answer will show the result.

Shandwick Place, 8*th Nov.*, 1834.

DEAR SIR,

In reference to your offer addressed to me, to furnish stone from Craigleith Quarry, for the works by which I propose to improve Leith harbour, you make the usual charge for carriage by the common road. Now I beg to know, were permission obtained, by Act of Parliament or otherwise, to lay a railway along the public road to the proposed works, at what rate per ton you would deliver the stone (carriage only); or, in other words, what would be the amount of saving effected by such a measure, including the expense of laying the railway? There would be required about 50,000 tons of stone, each stone upwards of two tons in weight (the carriage for such in your offer is 3*s.* per ton); 130,000 tons of stone under that weight (at 2*s.* per ton carriage); and say 125,000 tons of packing (at 1*s.* 6*d.*) per ton carriage). An early answer will oblige.

JAMES ANDERSON.

George Johnston, Esq. Craigleith Quarry.

Craigleith Quarry, Nov. 12, 1834.

DEAR SIR,

In answer to your letter of the 8th inst. I beg to say, that were permission obtained, by Act of Parliament or otherwise, to lay and use a railway along the public road to the proposed works for the improvement of Leith harbour, the amount of saving in the expense of carriage of the stone required would be very considerable.

The quantity of stone you require of different sizes amounts to 305,000 tons, the carriage of which, at the rates mentioned in my former offer, is		£29,875 0 0
But if the free use of a railway were obtained, the carriage of that quantity of stone could be done at 1*s.* per ton on an average,—say 305,000 tons, at 1*s.* per ton, is	£15,250 0 0	
And I could undertake to provide and lay the rails for the sum of . . .	2,000 0 0	17,250 0 0
In this way a saving would be effected upon the carriage of the stone to the amount of		£12,625 0 0

I am, &c.,
GEO. JOHNSTON, JUN.

James Anderson, Esq., Civil Engineer, Edinburgh.

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* The works of the wet dock or ship canal can be executed at very moderate expense, as they are all above low water-mark; besides, after the bulwark and sea-wall are built, the other parts of the works can be done at all times.

APPENDIX C.

LEITH.

No. 12.
Anderson, on the state of the Harbour.

Estimate for constructing a Deep-Water Entrance at Newhaven, and a Wet Dock, or Ship-Canal, &c. &c. communicating with the Western Wet Dock of Leith Harbour. Excavation of Entrance Channel, &c. 200 Feet Wide, at the Pier Head, 10 Feet at Low-Water Mark.

					£.	s.	d.
46,750	cubical yards in Entrance Channel, at 3*s*.	£7,012	10	0			
24,800	—— above low-water mark, and in the site of Sea Lock, and in the found of landward walls of pier, at 1*s*.	1,240	0	0			
					8252	10	0
	Low-Water Pier.						
6,011	Cubical yards of masonry in walls of pier, deep water founding, at 40*s*.	12,022	0	0			
17,280	—— in pier walls, above low water, of medium tides, at 20*s*.	17,280	0	0			
4,080	—— in landward walls of pier, one-half old and one-half new material, at 15*s*.	3,060	0	0			
60,480	—— of stone packing in interior or nucleus of pier, at 3*s*.	9,072	0	0			
					41,434	0	0
	Breakwater.						
280	Cubical yards of masonry in the walls of the Breakwater head, deep water founding, at 40*s*.	560	0	0			
685	—— ditto, above low water, at 20*s*.	685	0	0			
2,208	—— dressed square, large-sized rubble in piers, and arching to admit the receding tide, *measurement and half*, at 10*s*.	1,104	0	0			
10,575	Square yards of stone casing in breakwater, at 7*s*. 6*d*.	3,965	12	6			
23,748	Cubical yards of stone packing in ditto at 3*s*.	3,562	4	0			
					9,876	10	6
10,540	Superficial yards of causeway on pier, and head of Breakwater, &c. &c., at 5*s*.	2,635	0	0			
					2,635	0	0
45	Tons cast-iron feather bars for connecting masonry in deep water founding, at 8*l*.	360	0	0			
4	Tons of malleable iron bars, bolts, clamps, &c., for connecting the masonry at the extremities of pier, breakwater, and centre or defence wall of pier, at 20*l*.	80	0	0			
	Cast-iron lighthouse on basement of stone	500	0	0			
					940	0	0
	Sea Lock and Flood-Gates.						
4,800	Cubical yards of masonry in chamber of lock, at 30*s*.	7,200	0	0			
	Puddling, &c. &c.	250	0	0			
2,300	Square yards of arching in chamber, and the sills of flood-gates, at 15*s*.	1,725	0	0			
	Two flood-gates, wood and iron work, complete, at 1500*l*. each	3,000	0	0			
	Draw-bridge	750	0	0			
					12,925	0	0
	Works of Wet Dock or Ship Canal.						
5,300	Cubical yards of excavation in found of bulwark at 1*s*.	265	0	0			
280,800	—— in canal, &c., at 6*d*.	7,020	0	0			
	Puddling and forming slope	1,080	0	0			
		£8,365	0	0			
12,720	Square yards of bulwark, constructed of the best materials found betwixt high and low water mark, workmanship only, at 3*s*. 6*d*.	2,226	0	0			
2,120	—— particular dressed bulwark of Craigleith stone, at junction with retaining wall, at 7*s*. 6*d*.	795	0	0			
10,600	Cubical yards of rough dry rubble wall at back of bulwark, at 6*s*. 6*d*.	3,445	0	0			
5,300	Cubical yards in wall surmounting bulwark, of large-sized square rubble, in courses, hammer-dressed, scarped, and nidged, at 10*s*.	2,650	0	0			
1,090	Lineal yards of dwarf retaining wall, including cope, at 12*s*. 6*d*.	681	5	0			
4,240	Superficial yards of stone casing, for securing top of slope on north bank of canal, at 5*s*.	1,060	0	0			
1,800	Cubical yards of masonry in wing retaining walls, on slope at entrance gates of canal, at 9*s*.	810	0	0			
25,920	—— in wharf or quay wall, of large-sized, square rubble, dressed, &c. &c. in courses, at 9*s*.	11,664	0	0			
					31,696	5	0

APPENDIX C.

LEITH.

No. 12.
Anderson, on the state of the Harbour.

Entrance to the Western Wet-Dock. Pulling down and rebuilding part of the Return of Bastion Wall.

				£. s. d.
1,000	Cubical yards of masonry, to join retaining and parapet walls of canal, lime mortar, and workmanship only, at 5*s*.		£ 250 0 0	
1,400	——— in entrance walls to wet dock, at 30*s*.		2,100 0 0	
400	Square yards in sill of entrance, at 10*s*.		200 0 0	
	Flood-gate to wet-dock	1,100 0 0		
	Draw-bridge	750 0 0		
			1,850 0 0	
				4,400 0 0
	Forming a roadway along the quay between Newhaven and Leith Harbour			1,200 0 0
				£113,359 11 6
	Add contingencies, 10 per cent.			11,335 19 6
				£124,695 11 0
	Deduct saving effected on the carriage of stone by means of a railway, per Mr. Johnston's letter, of 12th November, 1834, 12,625*l*., but say only			9,605 11 0
	Reducing the total amount to the sum of			£115,000 0 0

On reflection, I thought it might be expedient to obtain the judgment of practical men respecting the prices enumerated in the foregoing estimate, not because I had any doubt of their correctness and applicability, but because it seemed to me that all who are interested have a right to be fully satisfied on this very important point. I accordingly requested the opinions of Messrs. Robert Dobson and John Forsyth,—the former being one of the most respectable builders in Edinburgh, and the latter having executed not only all the deep-water masonry of the piers at North and South Queensferry, but likewise that of Newhaven Pier itself.

I therefore subjoin their letter on the subject.

"*Edinburgh, Nov.* 18, 1834.

"SIR,

"Agreeably to your request, we have examined the prices of the various branches of your "estimate of the works you propose for the improvement of Leith Harbour, and, according to the "explanation you have afforded us, as to the peculiar manner of executing the works in question, "we are of opinion, that the prices affixed to each particular branch in your estimate are fair and "liberal; we are further of opinion, that if, as you propose, a railroad be laid down from Craigleith "Quarry to Newhaven, a very considerable saving of carriage would be effected. We are, Sir,

"Yours, &c.,

(Signed) "ROBERT DONSON.
"JOHN FORSYTH."

"*To James Anderson, Esq., Civil Engineer.*

JAMES ANDERSON.

No. 13.

No. 13.
Dickson, on improving the Harbour.

Description of Messrs. R. and R. Dickson's Plan for the improvement of Leith Harbour.

April 21, 1835.

THE advantages proposed by this plan are to render Leith Harbour, at almost all times of the tide accessible to vessels of a large size, to provide accommodation for the large steam boats, and low water landing places for the ferry boats, and others. To obtain these, it is proposed,—

1st. To extend the present wooden pier seawards, similarly constructed, for 2000 feet, which will bring it into 10 feet of water at low water, at the lowest spring tides.

2nd. At the end of this pier to build a dock about 400 feet square, having an entrance from the south; to obtain which, the extended pier is made to take a bend at about 250 feet from the dock, and to have part of this bend formed open below, upon pillars, to prevent the silting up of the entrance to the dock, by allowing the stream of the tides at all times to flow through the ends of the pier. The entrance to the dock to be defended by a breakwater of rubble stones; and further, to prevent the heavy seas from washing into it, wooden booms in grooves to be laid across the entrance. Low water landing places for the ferry boats, as also for the large steam boats, and other vessels, without going into the dock, to be constructed on the west side of the dock; and if thought necessary in heavy westerly winds, landing places might also be made on the east side of the dock.

3rd. To make a railway along the back of the present old wooden and stone pier, continued along the new pier to the dock, to obtain a good access to it from the shore. This railroad to be made double along the bank of the stone and old wooden piers, and single along the new wooden and extended piers. To admit of this the present new wooden pier will require to be increased in breadth as shown by the section on the plan.

4th. To obtain accommodation for the steam boats, and other vessels in the present harbour, for loading and unloading their cargoes, or being kept afloat, or almost so, it is proposed to extend the present custom-house quay, as shown on the plan, and inclose the harbour by a weir across it, nine feet high, having a gate in the centre fifty feet wide. This, by shutting the gate at the ebbing of the tide, will secure nine feet of water in the harbour at all times, which, we believe, can be done without injury to the operations of Leith Mills. The gate to be always kept open when the tide is higher than nine feet, by which means it would be little or no obstruction to the access to the harbour. By the extension of the Custom-house quay, space for four steam vessels to lay along the quays, of the size of those belonging to Messrs. Crichton and Ogilvie's Company, would be got above the proposed weir and under the bridge.

The expense of these works, not including the railway, is estimated as follows, viz.:—

No. 13.
Dickson, on improving the Harbour.

	£.	s.	d.
The Extension of the Pier.			
A safe criterion for estimating this is, the cost of the present new pier, which, for 1500 feet, cost 28,000*l.*; taking the further extension in the same proportion, it would be for 2000 feet, nearly	37,333	0	0
But as part of the extended pier is in deeper water, the expense would be increased by about	2,700	0	0
	£. 40,033	0	0
Dock.			
10,690 cubic yards of masonry under low water in sea and quay walls, at 40*s.*	21,380	0	0
22,090 cubic yards of ditto, above low water in ditto, at 20*s.*	22,090	0	0
84,400 cubic yards filling with rubble, packing, &c. between sea and quay walls, at 2*s.* 6*d.*	10,550	0	0
207 roods of rubble causeway, at 42*s.*	434	14	0
Swivel bridge, &c.	500	0	0
Breakwater, 500 feet long.			
16,700 cubic yards, at 5*s.*	4,175	0	0
Extension of Quay at Custom-house.			
Weir and Gate	2,000	0	0
	£. 101,162	14	0
Add for contingencies	10,116	6	0
	£. 111,279	0	0

No. 14.
Milne, on extending the Harbour to the east.

No. 14.

Report and Plan by JOHN MILNE, Esq., *C.E., for the Extension of Leith Harbour towards the East.*

GENTLEMEN, *No. 45, Prince's Street, Edinburgh, September* 4, 1838.

IN the month of November, 1836, I sent to the Commission a sheet of drawings and description of improvements, designed by me, for Leith Harbour, in the month of June preceding; and these having been read and discussed by your predecessors in office, as far as the then gloomy prospects of the port seemed to require, an unanimous vote of thanks to me was resolved upon; and it was intimated that my suggestions should receive full consideration whenever the affairs of the port should admit and require a discussion on the merits of plans for its improvement.

This resolution was every way satisfactory; but as new Commissioners have now been appointed,—partly of gentlemen to whom the natural capabilities of the harbour for improvement *may* be a new study,—and as there is now a probability of this question coming before you, I have resolved on publishing my views; so that each member of the commission may have a copy in hand, to enable him to approve or reject my proposal on satisfactory grounds.

This, however, is only a part of my reason for publishing at this time: the unfortunate position into which the affairs of the port have been placed—partly by the inadvertency of its ancient managers, and partly by circumstances over which they had no control—and the possibility of the public money being again misapplied, and the utter ruin of the port to follow thereon, afford a guarantee that every suggestion now brought forward to remedy defects, and to retrieve the fortunes of Leith, will meet with anxious consideration, however deficient in illustration it may be. It is not, therefore, solely with the view to instruct the Commission, further than I have already done, in the nature of my plans, that I now publish them, but to remove misconception in the public mind,—a misconception which may have arisen from my suggestions not having been described, except in one of the city newspapers, of course without reference to the drawings; the consequence of which is that some persons conceive that, by my plan, a much greater extent of berthage for the shipping is intended to be formed, under my estimate of expense, than what I ever intended or described; whilst other persons have intimated their doubts of the practicability of executing the plan, except at an enormous expense; and a third party, consisting of one or two individuals, have contended wrongfully, in the public papers, that, as "*engineers of great eminence have from time to time been employed to report on the capability of the harbour for improvement, my suggestions can only be intended to distract attention, and thereby defeat intended improvements*," &c. &c.

This anonymous writer appears to arrive at his conclusions very easily, without the aid of fact, and to persist in it, by circulating printed letters, even after he was made aware of his error. I have, therefore, no hope of being able to carry conviction to the mind of this person, nor to any who may be unwilling or incapable of considering my suggestions on their own merits; but as I rely on the "real well-wishers of the port," and on the members of the Commission individually, making themselves aware of what is the truth, and of what is not, and of the *circumstances which are to affect the expense and permanency and conveniency of any extension of the harbour now to be made*, I shall now proceed to lay before them all I can say at present on the subject. With this view I shall give a reason for everything I propose, and which reason shall be founded on acknowledged facts, and on principles the accuracy of which are universally admitted and received, as those by which the merits of any plan for the improvement of such a harbour as that of Leith ought to be tried. There has been too much dogmatizing already. Persons who do not think for themselves are apt to be misled by men of powerful minds: men to whom we are under a deep debt of gratitude for their management of other matters, ought, nevertheless, to decline speaking on this until they have made themselves masters of the elementary principles on which it is founded, and on *all the details of every plan proposed*. Talking at random should no longer be tolerated. The interests of the public demand that the merits of every suggestion be tried by *principles*, and not by the *opinion* of any person whatever. At all events, and with all deference, I venture to hope that the "*standing orders*" of the Commission, regarding plans and opinions on them, will now be,—"*Show us your reasons, and we will form an opinion for ourselves.*"

No. 14.
Milne, on extending the Harbour to the east.

Present depth of the water at the Middle Craig accounted for, and its permanency demonstrated, &c.

In the month of January, 1835, I published some "Observations on the Tidal Currents at Leith," and recommended the excavation of stone from the Middle Craig for harbour purposes, &c.; and, by reasoning on the circumstances which affect the deposition of sand and other silt, I was led to conceive that the water at the Middle Craig (from whence I proposed to quarry the stone) would soon become the deepest in the vicinity of Leith, were the then cross tide over Leith Sands stopped by any means whatever; and in this belief I proposed to make a harbour of the quarry-hole on the rock, and to connect it with Leith by a mound roadway over Leith Sands. *I had made no survey or soundings at this time*; my speculations were, therefore, founded on the depths, and direction, and strength of the currents figured in Thomas's Chart of 1815, in which the water is marked at only 7½ feet deep beyond the Middle Craig about 300 feet; nevertheless, as already noticed, I proposed a new entrance and harbour there. The idea, however, was too far-fetched, or else too problematic to insure for me a patient hearing. I was rebuked for it in the newspapers, and the whole was soon forgotten, except the fact that I had proposed an entrance where the water was only 7 feet deep. Meanwhile the building of the stone weir was progressing, and thereby stopping the *tide over Leith* Sands in the way I wanted; and, at the end of eighteen months after my proposal had been published, I sailed out to the Middle Craig to try whether the water was becoming deeper accordingly, *and I found* 12½ *feet instead of* 7½ *feet as figured in the Government chart of* 1815. My prediction was therefore verified, and I made those designs for a harbour now submitted to the Commission.

As already noticed, as regards these plans, I have been accused of an attempt to divert attention from those of Mr. Cubitt; and it is alleged that, as "Mr. Cubitt, Mr. Telford, Mr. Rennie, and other eminent engineers, have all surveyed and reported on the capabilities of the vicinity of Leith for a new entrance to the harbour, and as none of them have recommended the Middle Craig, my suggestions ought not to be considered."

Were it really the fact that any one of the above-named gentlemen had surveyed and reported on the capabilities of the place, I certainly would not have put myself to the trouble and expense of surveying and publishing, as I have done; but the contrary is the fact,—none of the gentlemen above named have ever (so far as I know) said anything whatever either on the past or present capabilities of the vicinity of the Middle Craig. The following is what the Parliamentary report of 1835 says about it:—Paragraph 1781, *et seq.*, where Sir John Rennie says,—"The object of the Admiralty, in sending me down to Leith at that time (1825), was simply to examine into the mode of executing Mr. Chapman's plan, it having been determined to carry that into effect." "My opinion, with regard to the improvement of the old entrance of the harbour, is certainly not very favourable. The additional depth of water which may be gained by any works that may be erected will be extremely trifling, and will be maintained at a very great and continued expense." * * "It appears to me, from what I have seen of the charts, and read upon the subject, that a very good entrance may be made near Newhaven, something similar to what I proposed myself in 1825." Here it ought to be observed that it was only from what Sir John had "*seen of the charts, and read upon the subject*," that he conceived that an entrance could be made at Newhaven;—he does not say that he surveyed for himself; and, besides, the *charts* which he examined showed only 7½ feet of water beyond the Middle Craig, as already noticed.

In like manner the attention of Mr. Telford was directed to a different quarter, and his visits at Leith were all previous to the water at the Middle Craig having become so deep as it is. At paragraph 120, Mr. John Gibb says,—"I was employed by Mr. Telford," in 1828, "when he was sent down under the direction of Government to make a survey of Leith *and the coast to the westward.*" Mr. Telford therefore had nothing to do to the eastward of Leith, and, although he had, as already shown, the water was only 7½ feet deep at the Middle Craig.

Paragraph 32, *et seq.*, Mr. Cubitt says,—"My estimate was founded on official documents that I found at Leith,—principally on Dall and Leslie's survey. I did not go to make a particular survey; it would have taken a long time, and involved a great expense." "I did not actually survey anything otherwise than the height of some tide gauges," &c.

It is useless, therefore, to allege, as some persons do, that these gentlemen surveyed and reported on the capabilities of the place now proposed by me as a site for a new harbour.

The present soundings are figured on my plans, and they were verified by several respectable persons at my request, and who also satisfied themselves that the depth at the rock gradually increases outward on a fine bottom of shingle and clay to the best hard clay anchorage in the Frith, distant only about a musket-shot.

It is now to be shown why it is that the water at the Middle Craig has become five feet deeper than it was in the year 1815, &c.

1. The permanency of the depth at this, or at any other place, depends entirely on the uniformity of the velocity of the tide, and on the material carried along with the current; and the deepening of the water at this place—the old entrance to Leith harbour—is now to be accounted for on these principles. I think it is necessary to do this, as the permanent utility of any harbour in the vicinity of Leith will depend upon its adaptation to the circumstances which are known to affect the deposition of sand, gravel, &c.

It is agreed to by every person who has experimented, and by marine engineers in general, that the following table shows the sorts of material that will lie at different velocities:—

Velocity in miles per hour.	The bottom that just bears such velocities.
One-sixth	Ouse and mud
One-third	Plastic clay
Two-thirds	Sand
One and three-fourths	Gravel
Two and 1·32 Two and 8-11	Pebbles Slivers Shingle
Three and 9-22 Four and 1-11	Boulders Shale Stratified rocks.

APPENDIX C.

LEITH.

No. 14.
Milne, on extending the Harbour to the east.

2. Hence, when the bottom is known, the velocity of the tide which passes over it can also be estimated, and *vice versa*.

3. Hence also in the Frith of Forth, where all the different sorts of material are occasionally held in suspension in their respective currents, the heaviest current must deposit the heaviest of its silt on the instant of its being carried into stiller water;—that is, a current running 1¾ mile an-hour must deposit its gravel when it meets a current running at the rate of two-thirds of a mile per hour.

4. Hence also, whenever a current shall become expanded by the widening of its course, as is the case where the water passes through the archways of a bridge, or ravines between rocks, as those east of Leith, deposit must lie in the expanded basin, because the velocity of the water in it is less than that of the current which brings the silt.

5. Hence also, in the case of two or more currents blending into one another (as was lately the case at the site now proposed for an entrance to the harbour), the tendency to deposit is constant, whether the currents run parallel to or at an angle to one another, because the currents destroy each other.

6. Hence also, when a bank has been formed by two or more currents coming in contact, either at their sides or otherwise, the silt deposited can be removed, either by increasing the velocity of one of the currents, or by stopping it; because, in either case, the increased strength of the current is able to take away what was brought by weaker currents.

These being the circumstances which affect deposition, it is easy to account for the deepening which has taken place of late at the Middle Craig, and as easy to foresee what must now take place in the cess-pool west of the Old Harbour.

It appears that, some years ago, the line of low water lay beyond the outside of the Middle Craig, so that persons still living walked round the rock on dry sand; but, instead of this bank, there is now 12 feet of water at lowest ebb, as has been already noticed. This bank has been taken away by the increased strength of the tide at the place, and that increase of current has been occasioned by the following circumstances.

It is admitted by every person, that, previous to the extension of the breakwater and stone weir at the mouth of the Old Harbour, the flowing tide ran westward over Leith Sands, between the beach and the Mortella Tower, at the rate of 1½ mile an-hour. This current, therefore, carried westward to the harbour a good deal of sand and small gravel from the outside of the Middle Craig to the stiller water about the harbour (Table 1), but the ebb-tide ran eastward over Leith Sands at the rate of 2½ miles an-hour; that is, with strength sufficient to carry mud, sand, gravel, pebbles, shivers, shingle, away from the harbour to the Middle Craig (Table 1), where, after passing through the hollows between the different rocks, this ebb current expanded and blended into that which was running on the outside of the reef, and deposited its silt accordingly. (5.) That is, the ebb which ran eastward took away from the harbour all the material brought by the flood which ran westward, as also that which was brought down by the river; hence, the proper bar of the river was at the outside of the Middle Craig, and people still alive walked round the rock on sand accordingly; and from thence vast quantities of sand were washed with easterly gales into the mouth of the Old Harbour. This made some persons believe that the Middle Craig was the place "from whence all the sand that choked the harbour came; and that very little or no sand comes down the river." I see no reason for this opinion, and shall notice it at another place. In the mean time I shall only observe that there is good reason to conclude that *all* the sand about Leith is the product of the river, and that it settles down whenever it comes into still water, and is occasionally raised and driven about by extra currents and a heavy sea. Circumstances, however, are now changed; both ebb and flood tides over Leith Sands have now been lessened to a great extent, and the water has deepened at the Middle Craig accordingly (6), by the comparatively uninterrupted action of the current; and when the stone weir, at present in progress of being built, shall have been extended sufficiently far, the deepening effect will become still more evident; the shingle, which lies outside the Middle Craig at present, will work in shore as far as the rocks admit. The water, however, is deep enough already for every practical purpose, being 12 feet deep *exactly at the line of low-water; and this is the only place within many miles of Leith where it could be shown that a deep entrance could be permanently maintained by natural means, and where no deep-water buildings are required to screen the channel of the harbour.*

I have now described the circumstances which affect the deposition of sand, &c., and those under which the water has become deeper at the outside of the Middle Craig; and as this rock is, on the average, three feet above low-water already, and is a fixed object in the tide, the same as the piers about the entrance would be, it would be unreasonable to suppose that an entrance to the harbour here would become silted up; on the contrary, we have seen that an immense bank of sand has been taken away, that the water has become five feet deeper, even although all the rubbish dredged up from the Old Harbour for many years has been laid down in this vicinity; and it is certain that any building that would be required on the rock to complete the entrance would not lessen the deepening effect of the water; on the contrary, by stopping the tide all over Leith Sands, as this new harbour would do, the current would be augmented at the mouth of the intended channel. In all such situations, however, care must be taken to proportion the area of the enclosed basin, and the width of the entrance, in such a way as that the current in at the mouth during flood-tide shall not exceed *two-thirds* of a mile per hour, otherwise sand would be dragged into the habour (see Table), and the still water of the ebb, although of equal velocity, would not take out the silt again. This is easily determined. The areas of my enclosed basins are, together, about 90 acres, or 435,600 square yards, and the rise of the tide is somewhat less than three feet an-hour; but, taking it at three feet, and the depth of the entrance channel, at half an hour after ebb, at 13½ feet, and the width at 300, as on the plans, we shall have, for the sectional area of the entrance, $\frac{300 \times 13\frac{1}{2}}{9} = 450$ superficial yards; and since the area of the enclosed basins is 435,600 superficial yards, and the depth of water to be run into it in one hour is one yard, it will give $\frac{435,600}{450} = 968$ lineal yards, or rather more than half a mile of velocity, to the water during the first hour of flood; that is, by supposing that the bottoms of the whole of the inner and outer basins are below low water, and that, therefore, the first of the flood would spread over the whole of their areas, which, however, is not the case; on the contrary, as seen in the plans and section, the water will be confined to a mere channel only; and by the time that the water shall have risen above the sand bottom of the inner harbour, the entrance channel will have become deeper, and the

APPENDIX C.

LEITH.

No. 14.
Milne, on extending the Harbour to the east.

current inward, therefore, slower. Hence it is evident that the velocity of the water will never exceed one-sixth of a mile per hour, and that nothing heavier than ouse could enter this eastern harbour. I shall have occasion to allude to this fact at another place.

The above calculation is only an approximation sufficiently near to the truth. The species of arithmetic to which the subject belongs would not be generally understood; I have, therefore, given it in a simple form.

The bottom of the channel being 12 feet below low water, sand cannot be washed in with the waves. It has been often proved that their agitation does not penetrate farther than a few feet below the surface. This can be shown by putting down a glass tube about five feet, on which it will be seen that the water in the tube above the mean level of the sea does not rise and fall with the wave on its outside; and that, even when the waves are three feet high, the water in the tube does not rise and fall more than a quarter of an inch.

In shallow water, however, circumstances are very different. The waves wash in all sorts of silt very fast, whether there be an assisting tide or not; but neither the tide nor waves can bring silt into this channel. Indeed, there is not a pound in the sea near the place; and, as the tide now runs fully two and a half miles an-hour, it is impossible that any sand can lie at the outside of the Middle Craig. (See Table.)

When speaking on the propriety of extending the stone weir at present in progress of erection, with the view to prevent the sea from bringing sand from the Middle Craig to the Old Harbour, Mr. Cubitt said, in his report, that, by stopping the cross-tide over Leith Sands, by means of this weir, "*the strength of both flood and ebb tides would be so much augmented outside the Black Rocks, Middle Craig, that no deposit would lie there.*" His meaning is, that, when no sand shall accumulate at the Middle Craig, none can be brought from it by the sea to fill up the channel of the Old Harbour; and, accordingly, the weir being built, no sand now lies outside the Middle Craig.

Mr. Cubitt, therefore, said much more in favour of the Middle Craig as a site for a new channel than he did say in support of his own proposed western channel. When interrogated before the Parliamentary Committee, whether "dredging would be a recurring expense in the event of his harbour being constructed," he says, "*That would depend upon circumstances.*" Upon sand getting in, perhaps he means.—Paragraph 42.

Mr. Walker says, that "Mr. Cubitt's plan goes only to nine or ten feet water at the entrance; the additional depth is to be obtained by dredging; and to support it and the artificial depth in the harbour without great expense is, to say the least, problematical."—Report, paragraph 705. And at paragraph 695 he says,—"If a new 'Western' harbour were made, not only the property in Leith would suffer, but also the Old Harbour would be, to say the least of it, partly neglected, because there would be comparatively deep water in the new harbour. Then I quite agree that the additional depth I have described could not be maintained without dredging; but it seems agreed that, in order to get deep water in 'Mr. Cubitt's' harbour, dredging would be required; and I doubt whether more dredging might not be required in the harbour, and at this entrance, than would be required for the additional depth that I have supposed the old harbour to be capable of being made to." Here we have only doubts and opinions without any reason for them. Let us see: The entrance proposed by Mr. Cubitt is 150 feet wide in 9 feet water; and the area of his basin is 388,000 superficial yards, as nearly as I can measure it from his plan; and the depth of the entrance at half-tide being 18 feet, when the whole of the bottom of his harbour would be covered with water, the sectional area is $\frac{150\times18}{9}=300$ superficial yards; and as the rise of the highest tide is nearly three feet an hour, the quantity of water to flow in at the entrance will be equal to the area of his harbour in square yards; therefore, $\frac{388{,}000}{300}=1293$ lineal yards, or the velocity of the water in at the mouth of this harbour per hour; but this velocity is more than two-thirds of a mile per hour;—all the mud and sand, therefore, driving about at the outside, may be expected to come in. (See Table of Velocities.) This, however, could be obviated by making Mr. Cubitt's entrance wider than designed; but then the shallowness of the water, and its proximity to the mouth of the river, would expose it to silt by the waves driving it into the harbour. The still water, however, likely to lie about this entrance, is more to be feared than either the waves or the current in at the mouth. So far as I can see, after the stone weir at present building at the mouth of the Old Harbour shall be completed, the line of still water and tide will be G H. Of this, however, I am uncertain; I have never had an opportunity of surveying the spot, nor of ascertaining the currents there. I therefore reason only from analogy. Were the line of still water to be G H, Mr. Cubitt's breakwaters would have to be extended 1000 feet, and thus increase the expense very much; but it must be done if the plan shall be executed in any way, as still water and a deep channel are incompatible. I am aware that several gentlemen about Leith (and for whose opinion upon other matters I have a great respect) conceive that, as "little *or no sand* comes down the river, and as the stone weir is now extended so as to prevent it from drifting in from the east, the site of Mr. Cubitt's entrance can never be chocked up;" and to support their first position, that "little or no sand comes down the river," they say that "nothing but soft mud is to be found behind the docks and in other eddies of the harbour, where the sand would lodge if it did come down." This, however, is altogether erroneous. We must not look for sand where there is *no* current to carry it; there is no sufficient current over the flat behind the docks, and, therefore, there is no sand at that place, although a vast deal goes down the stream. At paragraph 597 of the Parliamentary Report, Mr. Jardine distinctly says, "I know that a great quantity of gravel, and sand, and mud. are carried down from the upper part of the river every flood."

6. I have not filtrated the water of Leith river, so as to estimate fairly the quantity of sand which it brings down after rain; but I can depend upon what occurred at a bend of the river Esk, near Musselburgh, about six years ago. The Esk enters the sea at about 5½ miles from the mouth of the "Water of Leith," and the soil drained by both streams is equally well cultivated. The ground at the bend of the Esk lies upon the convex edge of the stream, and is about 5 feet above its channel, and the flat haugh where sand was deposited was about 9 acres. After a heavy shower the Esk rose over the haugh, and left, in course of one hour, about 2368 cubic yards of sand, which was afterwards made the nucleus of an embankment; and I estimate this deposit at about $\frac{1}{1000}$ of the quantity which must have been borne along in the channel of the river to the sea. Upon the whole, therefore, the opinion that little or no sand is brought down by the Water of Leith, appears to be ill-founded. On the contrary, we must conclude that all the sand which drifts and shifts upon the bar is the product of the

APPENDIX C.

LEITH.

No. 14.
Milne, on extending the Harbour to the east.

river, which deposits its grosser sand there, and leaves its mud in the harbour, or wherever the water is quiet. But, even although the *opinions* now under review were correct,—were it really the case that "little or no sand comes down the river,"—that would not prevent the space between the stone weir and Mr. Cubitt's eastern breakwater from being silted up. If the sand has always "come out of the sea" from the east, it will surely not be hindered now by the stone weir. It has only to come round the outside of the Mortella Tower to fall down in the still water about the entrance of the old and the proposed new Western Harbour. Upon the whole, the cesspool, west of the old harbour, appears to offer a doubtful entrance.

My object here is not to raise objections to the proposition of Mr. Cubitt, or of any other person, but to show that the improvement on Leith harbour which I propose is as much entitled to a patient consideration as theirs; and I have no doubt whatever, that, had Mr. Cubitt, Mr. Walker, Mr. Telford, and the other able engineers, seen the spot and the depth of water now at the Middle Craig, they would have preferred this site, above all others, for a new channel.

The approachability of an entrance from the deep water at the Middle Craig is now to be considered.

The maps will be found to give an imperfect idea of the room about the place for manœuvring a vessel into port. Its locality and the quality of the rock, &c., would be best understood by visiting it at low water, which can be done on foot or in a boat.

The entrance may be formed in the deep water on the west side of the Middle Craig, between that rock and the Mortella Tower rocks, exactly in the original channel of the old harbour; or it may be formed on the north-east side of the Middle Craig, where the water is deeper, and where the expense of constructing and maintaining it would be much less; or the entrance may be formed in the rock itself, which, in the mean time, appears to be every way the preferable modification of the general plan for connecting the deep water with the old harbour and docks.

The situation and form of the entrance, however, are not to be determined on, until every circumstance of tide, approachability, and expense of constructing it in different places in this vicinity, shall have been fully ascertained.

There is a little bay on each side of the intended entrance through the rock, which could be made safe at little expense for a vessel turning into, in the event of her "*missing port.*"

Symonds' Rock lies north-west, distant about 3000 feet, with six feet water upon it at the lowest ebb of 16 feet tides, and 4 feet at 18 feet tides, and the intermediate soundings are 12 feet. There are no other rocks in the offing, and, this being small, it could be quarried down when the increased trade of the port shall render that necessary. An entrance here would be farther from rocks than any entrance proposed to be made west of Leith, as the maps and plans will show.

The line of low water here lies in the same direction to the sea and winds as that of Granton, the aspect of which has been highly extolled both by mariners and engineers, and there is a much more roomy sea.

The original entrance to the old harbour was from this place,—its approachability is therefore proved by experience. The direction of the intended channel is the same as that of the old harbour, whilst its form, in No. 4, being that of a triangle, with the entrance 300 feet wide at one of the angles, vessels could enter with the wind in any direction whatever; and this, with the old entrance, would be *two* to the old harbour, either of which could be taken by vessels, according to circumstances.

The site of the proposed entrance is more protected from the sea than Trinity or Granton; for in all depths less than 30 fathoms it has been often proved that the *magnitude and force of the waves are always as the squares of half the depth over which they pass*; and as the depth between the Middle Craig and Inchkeith is less than the depth between Granton or Trinity and Kinghorn-ness, from whence the heaviest tide enters, the agitation of the water at our proposed entrance must be less than at either of these places accordingly. Any objection, however, to the weight of the sea at any of the proposed entrances deserves no consideration whatever. There is no sea at all in the Frith of Forth as compared with that on the shores of the ocean, where, nevertheless, there are many excellent harbours. The Parliamentary evidence is very decided on this point, as at paragraphs 692 and 1474.

My intended improvement is to enclose 80 acres, more or less, on Leith Sands; and to connect this great basin with the deep water at the Middle Craig, and with the present old harbour and docks, so as to admit of much larger vessels entering them than can at present. This connection can be effected in a variety of ways: such as by opening a passage through the old pier, between the new basin and the old harbour, so as to allow vessels to enter from the new basin to the old harbour and docks, with the present depth of the old harbour only; and until the dock-gates shall be widened and deepened, and the docks underfooted, there is no need for doing more; but, after that expensive improvement shall have been carried into effect, as has often been proposed, the passage across between the new basin and the old docks can be made and kept deep by dredging, as is the practice at the present time; or the old harbour can be formed into a wet dock, to lock into the new basin, by which means vessels could leave and enter the old harbour and docks at low water, or at any other time of the tide; or, by making a wooden trough across the old harbour, that is, between the old docks and the new basin, with openings in its sides at proper intervals, and a sluice at its end in the wet docks, a channel as deep as is necessary would be formed in the old harbour, and kept clear between the dock-gates and the new basin merely by drawing up the sluice, so as to allow the water of the docks to rush along the trough and out at the holes in its sides against the bottom of the channel. The head of water in the docks being 16 feet, the force would be sufficient to tear up the bottom, even although it were rock; but sand and clay are the only materials to be removed; and that the trough would answer the purpose there can be no doubt whatever. It should be placed a foot or two below the level of the present bottom of the old harbour, so as to allow vessels to pass freely over it. A deep channel between the docks and the new basin, however, as already noticed, would be altogether unnecessary until the present dock gateway shall have been widened and deepened, &c. When that is done, the improvement can be rendered available.

The new basin is to be formed, on its west side, by a wall between the lighthouse on the old pier and the northern extremity of the Middle Craig; and on the east side by a wall between the foot of Constitution Street and the said northerly extremity. The old pier, therefore, forms part of the landward boundary; and wharfage from thence to the foot of Constitution Street is to be extended at this time, as also a tide pier on the line of the street called the "Shore of Leith," to be projected 500 feet or more into the new basin; that is, about 1750 feet of berthage is intended to be formed at this time, in a way suitable for docks or wharfage, as the case may require at an after period. The inside of the

No. 14.
Milne, on extending the Harbour to the east.

great basin will not be excavated farther at present than to allow vessels to pass and lie freely; that is, a channel 240 feet wide at the bottom, and 400 feet wide at the surface of the present sand, all the way between the Middle Craig and the old harbour, and from thence, along the new berthage to Constitution Street, is to be excavated until the water is 30 feet deep at the highest tides, and 12 feet at lowest tides. This channel is 90 feet wider than what Mr. Cubitt has proposed for his "Western Harbour;" and vessels could enter or leave it at any time of the tide. The channel, although wide enough as proposed, can be widened more by "ballasting off" the sand at leisure. It is from this place that the sand for ballasting is carted at present. Were the vessels once into this new basin, they would get ballast free of expense. The western and eastern walls are to be only mounds of stone formed upon the sand, in the mean time, in such a way as to admit of their being faced up with the stone of which these mounds are now to be formed, at a small expense, as dock-walls or berthage, at any time whenever the demand of trade shall require. The eastern wall will be a loose rubble mound only, protected from the sea by the intervention of 60 acres of dry ground on its east side, which is to be formed with the sand and clay to be excavated from the great basin. This space would soon be fit for feuing; and it is the property of the City of Edinburgh, and could be increased in extent by continuing to excavate the great basin and to lay the stuff down here.

The western boundary wall is to be a rubble mound of the same description as the last, but faced with masonry on its west or seaward side, and the space between it and the Mortella Tower to be allowed to silt up of its own accord. This space of 60 acres would soon be the best possible for ship-building, wood-yards and engineers' workshops. It would be impossible to find a spot so suitable, and there is no other room near the old harbour, nor near to any of the proposed western harbours, for these essentials to the prosperity of the port. This space is also the property of the City of Edinburgh.

The eastern and western mounds, which form the boundary of the new basin, assume the character of substantial breakwaters, at 300 feet nearer the shore than the rock on which they are to be built, of the best masonry, laid in mortar at six feet thick, and solidly packed with stone behind; much building, however, is not required. As already noticed, the rock being on the average three feet above low water, it may be said that the breakwaters to be built upon it are also three feet above low water already. Masonry in deep water is very expensive, and sometimes impossible; nevertheless, all the other harbours proposed to be built in the vicinity of Leith are formed entirely by buildings in deep water. The muddiness of the sea is a serious objection as regards seeing how to place the stones. One might as well attempt to build in *treacle*. I have been sadly puzzled with it. It was attempted at Granton by an able engineer, but abandoned; and I now learn that the pier under water is not founded with ashlar as was intended, but of a loose mound of stone thrown into the sea. Our sticklers for a harbour to be built in the water should think on these matters before they raise objections to my plan, which is to avoid these difficulties, and to lessen the expense and risk of damage during the progress of the works.

These breakwaters upon our rock are to be built upon the margin of the channel or outer harbour, which is to be excavated in the rock. This outer harbour contains nine acres, less or more, and has the form of a triangle, with the entrance 300 feet wide at the northern angle, and a low breakwater separates it from the great basin.

Between this separating breakwater and the land there is an excellent space upon the rock for a fort, and this is the only spot in the vicinity of Leith where a fort could be built so as to protect at once the shipping and the city.

The excavation of the channel, or outer harbour, in the rock, below the level of low water, appears to be the only part of the undertaking which is considered to be difficult; but it will be presently shown that this is a *profitable* rather than a *formidable part of the execution* of the new harbour.

The rock is excellent stone for harbour purposes,—not *whin*, as some persons allege; and, if tradition be correct, the present old pier was built of stone from it. Be this as it may, it stands the weather well. The weather-crust upon the stone of our rock does not penetrate more than one-eighth of an inch, although the stone has been exposed to alternate wet and dry at least for 4000 years. It is intended to quarry it out of the intended channel, and to build up the material into the breakwaters and piers; and the manner of effecting this may be as follows:—The rock is eight feet above low water at the landward end of the channel intended to be cut; the quarriers and masons could, therefore, work here at a portion of the cut six hours at a tide at the very beginning of their operations. They are to found the breakwaters on each side of the channel, and form a temporary coffer-dam of rubble-stone and clay at the ends of the cut, and in the centre of the breakwaters and rubble coffer-dams a nucleus of clay is to be formed along with the building, by which means the sea would be entirely banked out of the enclosed portion of the intended channel, after which the quarriers could work at all times. In the mean while, however, whilst this portion is in progress of excavation, another portion, or the remainder of breakwaters, is to be founded on the rock at low tides, the clay nucleus filled in, and the sea shut out at low water with a sluice at the lowest part of the rock, so as to enable the workmen to proceed until the sea shall rise to the top of the surrounding embanking breakwaters. In this way the rock enclosed within the surrounding breakwaters could be quarried down, and the channel formed to the level of low water without the aid of any pump; but when all the breakwaters and temporary embankments have been carried up above the level of high water, or when the engine pit has been formed, a steam-engine is to be employed to pump out any water that may filtrate through the rock, &c.; and if it were found that a vast quantity of water filtered into the quarry, a dike of clay is to be formed in front of the workmen so as to dam up the water between it and the surrounding breakwaters, and, a sluice being placed at the level of low water, this dam could be run out twice every day when the tide is low, so that the excavation would not be interrupted even although a vast deal of water were to find its way into the space enclosed by the breakwaters, &c. The nucleus of clay within the breakwaters need not be more than four feet thick; and by making the building eighteen feet thick between the clay and the inside of the excavated channel, the resistance of the building would be more than five times equal to the pressure of the sea, as any of our elementary treatises will show; nevertheless, whilst the excavation of the channel is going on, the breakwaters will be made much stronger than this, by building the temporary rubble-stone gangways along the backs of the breakwaters.

After the channel of the harbour has been excavated the clay nucleus is to be taken out of the breakwaters, and the cavity carefully packed with stone, piece by piece, at leisure. The method here proposed for banking out the sea by means of clay is, so far as I undertand it, the same as that proposed for getting at the inside of the docks at Trinity, where the water would be fifteen feet deeper on the

Appendix C.

Leith.

No. 14.
Milne, on extending the Harbour to the east.

clay, and where the difficulty of excluding the sea from the inside of the docks would be greater accordingly. I have mentioned clay as the embanking nucleus in our breakwater; but a solid wall of stone and mortar would be better and less expensive, as it would not require to be taken out.

The inducement to make the channel through the Middle Craig, instead of in the water at either of its sides, is the stone to be got, and the small quantity of building required to complete the channel of the harbour. The cheapest stone for pier purposes at Leith costs 13*s*. 6*d*. per cubic yard. An engine-work has just been completed, under my direction, for which we got six ship cargo from Fife, as the cheapest to be got. The blocks were, in general, of the size fit for harbour purposes, being for fixing machinery upon, and they cost 16*s*. 3*d*. per cubic yard, delivered at Fisherrow, exclusive of the shore-dues. I am, therefore, in no mistake about the price of stone; but excavations of the nature which I have proposed have been effected at many places for far less. At the Troon harbour the cost of excavation was 1*s*. 6*d*. a cubic yard; at Peterhead the granite cost from 1*s*. 6*d*. to 2*s*. 6*d*., according to the circumstances under which the different portions were quarried. I myself have effected excavations similar to this, and I know what can be done and what cannot, and could commence this work in full confidence of complete success.

Indeed the difficulty here is as nothing compared with that which has been successfully encountered, as, for instance, at the sea-locks of the Caledonian Canal at Corpack and Fort Augustus. At Clachnaharry, no rock had to be excavated; but the bottom on which the sea-lock had to be founded consisted of something worse,—of soft mud to the depth of 55 feet,—so soft that it could not bear the weight of the masonry. To obviate this, the engineer carried out an artificial mound of earth, 1200 feet into the sea, into 28 feet water. The mound of earth was greater than the whole of the Middle Craig above the bottom of the intended channel; but to compress the bottom still further, an immense quantity of stone was laid on the top of the mound, and the whole allowed to subside for six months; after which the pit for the canal-lock was made in the middle of the mound, the building raised, and the mound allowed to wash away with the waves of the Beauly Frith. Indeed, such excavations as that which I propose are often made for the sake of the stone alone. At Mathers, east of Montrose, there is an extensive lime-quarry, which was begun to be worked within the tideway. The bed of stone, however, soon dipped so low towards the land that it became impossible to quarry it any more; but a mound of clay, stone, and other rubbish, having been formed between the rock and the sea, the sea was excluded from the workings, and the lime is now quarried out at a level more than 40 feet below the tide. Coal for burning this lime is brought from England; nevertheless, under all disadvantages, it is still worked at a profit. There is no more difficulty in forming a new channel for the harbour through the Middle Craig than there was in quarrying this limestone.

My estimate for the execution and material of plan No. 1 is 226,703*l*. I have not yet surveyed the site of this entrance sufficiently well; but if the bottom be sand, the channel can be made much deeper than the present soundings, merely by allowing the ebb tide, which runs over the stone weir, to run out at the mouth of this harbour. That tide is at present two and a half miles an-hour, but it can be diminished or increased at this eastern entrance by building the weir higher or otherwise. This tide out, however, I fear, would be inconvenient for vessels coming in after ebb; but were the plan agreed upon, the breakwaters might be shorter than in the drawing, and the expense 20,000*l*. less; but as it may be bounded on the west by the lines A B C, a saving of material and workmanship may be effected to the extent of 15,000*l*. by facing that wall on the west side only, which would reduce the cost to 211,703*l*. And by taking as much stone from the Middle Craig, and other rocks in the vicinity, as can be got above water, without purchase, this estimate of 211,703*l*. can be reduced to 195,000*l*., independently of the shortening of the breakwaters as above. The great length of the channel to be excavated is, however, a heavy item here; and the entrance is too near the rocks, but is not more so than that of Mr. Cubitt; neither would the expense be greater.* No. 2 is a much better plan. The water is deeper, and the rocks are all built in, so that the entrance would be perfectly safe. The ebb over the weir could be made to clean out this entrance, as in No. 1, were the western breakwater made on the line A B. The estimate for it is 188,978*l*., including the purchase of material; but by taking what can be got about the rocks above water, this estimate may be reduced to 171,978*l*.,—that is, to 22,669*l*. less than what is necessary to complete Mr. Cubitt's harbour, at the same rate of strength and expense, as is shown at page 29. No. 3 is for an entrance through the rock; the estimate for it is 92,232*l*. Instead of forming an outer harbour, as in No. 4, its entrance is only a channel 300 feet wide, bounded on the west by the dotted line D E F; in all other respects it is the same as No. 4, of which I shall give a detailed measurement and estimate, to show the strength and prices which I have allowed for each of my four modifications:—

Detailed Estimate for No. 4.

	£.	*s.*	*d.*
Banking out the sea from the channel to be made in the rock, and for the use of tackling, railways, steam-engines, &c.	5,200	0	0
Wharfage between the "Shore of Leith" and the foot of Constitution Street, and a tide-pier, in all 1750 feet of berthage; also sides of gateway leading to the Old Harbour, each 230 feet, in all 2210 lineal feet, below water, and $13\frac{1}{2}$ feet deep, and 9 feet thick,—hammer-dressed block ashlar, slipped down at an angle, or $\frac{2210 \times 13{\cdot}5}{9} = 3315$ superficial yards at 20*s*. per yard, which is equivalent to 43*s*. 6*d*., including the price of stone	3,315	0	0
Carried forward	£8,515	0	0

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* Six months after I had designed this plan, it was unwittingly presented to the Commission by Captain Stoddart, one of the late Commissioners, as his own; and, subsequently, in the *Observer* newspaper, of date 11th April, 1837, he gave as a reason for his doing so, that he conceived *I had abandoned this plan for No. 4, with the entrance through the rock.* I have not done so: I have neither fixed on nor abandoned any of my plans; and my reason is as explained at former pages of this paper,—a reason which was also given long ago in my "Description of the Plans" sent to the Commission, and of which Captain Stoddart had ample opportunity of making himself aware. He has now, however, *declined* a public challenge to have his pretensions investigated; I therefore conclude that he has withdrawn them.

APPENDIX C.

LEITH.

No. 14.

Milns, on extending the Harbour to the east.

	£.	s.	d.
Brought forward	8,515	0	0
Ditto, ashlar facings of wharf and tide-pier above water, at 19½ feet above low water, 2210 feet long, and average six feet thick, laid in mortar, or $\frac{2210 \times 19\cdot5}{9} = 4788$ superficial yards, from which deduct for inclination of tide-pier to low water 978, gives 3810 yards; which, at 13*s.* per yard, is equivalent to 40*s.*, including the price of stone	2,476	10	0
Outside breakwater on the rock, ashlar facings, 500 yards long on the rock on the east side, and 100 on the sand, terminating at X, in all 600 yards, and 600 yards on west breakwater, terminating at Z, being 18 yards over both sides on the average,—that is, by making these breakwaters seven feet above the highest tide, and at six feet thick, laid in mortar, best masonry, 21,600 yards on sides; to which add for ashlar paving on top, at three feet thick, reduced 3000 yards; in all 24,600 superficial yards,—to which add 2000 yards, for additional depth required between the rock and the terminating points X and Z, or 26,600 superficial yards; at 12*s.* per yard, equivalent to 34*s.* 6*d.*	15,960	0	0
Ditto, hammer-dressed block facings, laid dry on the breakwater which separates the Outer from the Inner Harbour, and on the western boundary-wall of the great basin, from Z to the back of lighthouse, slope I on 1, or 25 feet on the side of the mound. This would admit of the facing being run five feet below the surface of the sand, so that it could not be washed away on the west side, where indeed silting must take place as soon as this western wall is built; or 12,799 superficial yards, at 5*s.* per yard, equivalent to 15*s.*	3,199	15	0
Note.—The facings of the present breakwater, about the timber-basin, would form one-fourth of these, which, at half-price, including the price of the material, would save 559*l.* of this sum.			
Ditto, packing in all the breakwaters and mounds between the rock and the beach, and which mounds are 18 feet high, 10 feet broad at top, and 40 feet at bottom, and excluding 3 feet thick for facings, and including all stone packing in the wharfage, or 138,861 cubic yards, at 9*d.* per yard for carriage on the railway from the quarry on the rock, equivalent to 5*s.* per yard	5,207	5	9
Ditto, stone to be quarried out:—Outer harbour, say 9 acres = 43,560 superficial yards; and the rock being on the average 3 feet above low water, and to go down 12 feet below low water, the depth would be 5 yards; therefore 43,560 × 5 = 217,800 cubic yards of stone, by taking it out square down by the sides of the breakwater; but deduct for curves to be left there 17,800 cubic yards, or 200,000 cubic yards at 1*s.* 6*d.* to the workman	15,000	0	0
Note.—The quantity of stone required for all the masonry and mound roadways, &c., is only 193,880 cubic yards; but as the rock may not turn out a sufficient number of large stones with that quantity quarried, and no more, I have estimated for 200,000 yards to be quarried, although I do think that so much would not be required. Were my anticipations correct, this excess of 6120 cubic yards might be left unquarried, and 404*l.* thereby saved.			
Ditto, sand to be excavated from the great basin, and sunk from barges on Leith Sands, and otherwise carried so as to form dry ground there. Entrance channel, to beach length . . . 3,000 feet. Ditto from the side of this cut to Constitution Street . . . 370 Ditto branch cut to western channel in the rock . . . 1,200 4,570 Average breadth at middle of cut, slope being 1 in 3 . 370 feet. Mean depth of all the cuts . 8 Therefore, $\frac{4570 \times 370 \times 8}{27} = 501,007$ To which add cut from new basin to old harbour . . . 10,000 611,007 cubic yards, at 4*d.* per yard, which, however, is price enough even to cart it	8,516	15	8
Ditto, clay to be excavated from the channels:—United lengths of all the cuts, 4570 feet; mean depth, 12 feet; average width, 256 feet; or $\frac{4570 \times 256 \times 12}{27} =$ 519,964: to which add 12,856 yards for cut in channel between new and old harbour;* which makes in all 532,820 cubic yards, at 1*s.* per yard	26,641	0	0
	85,516	6	5
Contingencies at 10 per cent.	8,551	12	7
Total estimate	£94,067	19	0

Mr. Cubitt says, at par. 1834, that he could get the clay dredging done for a good deal less than 1*s.* per yard, even although loose boulder-stones were in it, as in his proposed basin.

Our channel is 240 feet wide at bottom; but by making it only 150 wide, as is proposed by Mr.

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[*] This excavation, as also the under building estimated for, is contingent upon the old dock-gates being deepened It would not be required unless that proposal were carried into effect.

APPENDIX C.

—

LEITH.

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No. 14.
Milne, on extending the Harbour to the east.

Cubitt, 120,000 yards of sand, and 180,000 yards of clay, now estimated, would be omitted, and 11,000*l.* of the above total estimate saved.

As already noticed, much of the sand could be ballasted off; and I have not yet made borings to ascertain whether 12 feet deep of clay must be excavated, as estimated here. From the information I collect, the sand is deeper than estimated, and the clay much less. If that be the case, my estimate can be reduced accordingly, perhaps to the extent of 10,000*l.* on this item. It appears that the late Mr. Rennie intended to build the present docks on the site proposed by me for this harbour; but that, from the sand being so deep, his foundation would have required to be too deep accordingly. This has been urged against my plan; but it is not a valid objection. Rennie did not want to found the docks deeper than a foot or two below low water, but we want to found at thirteen feet below low water; and if the clay be not deeper than this, a vast sum will be saved, as sand is much more cheaply excavated than clay. The old pier, however, is founded on the clay; and, so far as I can discover, it will be found all over Leith Sands, at a few feet below that level. The bed of clay is, in general, 22 feet thick.

Being uncertain, therefore, whether I ought to diminish my estimate, I have omitted to include causewaying on the wharf-heads, puddling about the wharf-walls, &c., gates in the channel between the new and old harbour, and a lighthouse. The prices I have allowed are high; and, from all I can see, the whole plan can be executed, complete, for less than my estimate.

Mr. Anderson allows only 40*s.* per yard for his deep pier foundings, and 20*s.* for his wharf-walls above water. Mine are estimated at 43*s.* 6*d.* and 40*s.* respectively.

Mr. Anderson allows only 7*s.* 6*d.* per yard for his breakwater facings; Mr. Cubitt, 4*s.* per ton, or 6*s.* per yard. Mine are estimated at 34*s.* 6*d.* per yard.

Mr. Anderson allows 3*s.* per yard for stone packing. Mr. Cubitt packs with clay at 0 per yard, except his price of dredging; and he also gets his shingle for nothing, which, however, would cost 1*s.* 6*d.* per yard. My stone packing is estimated at 5*s.* per yard.

As regards expense, then, the propriety of excavating the channel through the rock is very evident. No doubt the Middle Craig could be quarried down for stone for building any harbour in its vicinity; but this cannot be done at a very great advantage, except by banking out the sea so as to make the quarry dry in the way I propose. The rock being in the tide-way, a host of workmen would have to be kept in pay for working only a few hours during tide; indeed, although they could be all employed on the land after the sea has covered the quarry, their labours would be of comparatively little value. The rugged, wet, laborious exercise which the quarriers undergo, when working in this way, unfits them for labour for some hours after. I know this from experience. Banking out the sea, therefore, is what makes the stone of the Middle Craig valuable. There are, however, better blocks to be got at the eastern group, or "Black Rocks." This stone is beautifully white,—of the lias sort,—not laminated; and some of the blocks are more than fifty tons weight. A few of them might be floated to form the outer heads of our breakwaters.

As contrasted with Mr. Cubitt's harbour, I must again revert to his estimate. His estimate of 6*s.* per yard for his breakwater facings is altogether a mistake. Six shillings would not cover half the expense of the material; and he allows nothing whatever for dressing and laying down. But if what he proposes be sufficient for its purpose, my estimate can be reduced many thousand pounds by adopting the same sort of breakwater facings. On the other hand, if my facings be of that sort which Mr. Cubitt must ultimately adopt, his estimate must be increased to 147,687*l.*, which, after all, would only defray the expense of a clay, stone, and wooden embankment; and to make proper facings for his breakwaters with stone packing, 74,247*l.* must be added to his estimate, as is shown by Mr. Gibb, contractor, at page 18 of the Parliamentary report; which makes the expense of his harbour 194,247*l.*, for a problematical depth of nine feet of water. Still, however, his wharfage is objectionable; it is formed of wood—a destructible material, which ensures a continued expense. We have a good example in the late wooden bridge in the tide-way at Montrose. It stood about thirty years; but, from first to last, workmen had to be constantly employed upon it replacing timbers. The chain-pier also requires continual repair; and wherever the water is salt enough to support the destroying animalcules, wood will not stand.

The difference of expense of Mr. Cubitt's harbour and mine is 99,930*l.* in my favour, the interest of which would absorb more than one-fourth of the trade of Leith.

It should be noticed, however, that, by this small expenditure, only 750 feet of wharfage, and 1000 feet of berthage at the tide-pier, is proposed, by my plan, to be built at this time,—that is, 1750 feet in all; but as my eastern and western mounds are to be formed of large blocks of stone, quarried, at this time, from our rock, the material would be at hand for additional accommodation for the shipping, whenever that is wanted.

Hence the additional berthage would cost the price of workmanship only. My impression, however, is, that the 1750 feet of deep berthage, now proposed, is quite as much as the trade of Leith will require for some years.

As compared with the docks and harbour intended to be built at Trinity, the superiority of the eastern extension of Leith harbour is not less obvious, as, over and above the advantage of obtaining stone for almost nothing from the Middle Craig, it could be shown that, from the rock and sand being so high, twice the extent of berthage could be formed here at any time, with only half the material required at Trinity.

Were my plan adopted, steam-vessels could discharge alongside the rock in moderate weather, and passengers could get ashore on foot some time after the commencement of the works.

Were a sufficient number of quarriers employed to keep an engine of 10-horse power in work at pulling the stone up to the level of high water, as was done at the London Docks, where there was gravel, the whole excavation would be finished in the course of 4000 hours,—that is, in 167 days; but as so many workmen could not be employed until the works have advanced to a considerable extent, I could not say that the excavation would be formed in less than a year.

Mr. George Grieve, engineer for Sir John Hope, agrees with me that a 10-horse engine would be quite sufficient to pump the water from the quarry, under the circumstances I propose. No person knows better about it than him. He has now been working thirty years under this rock, or under the series of which it forms a bed; and from mining under the sea, as he has done, he is aware of the compactness of the rock—of its fitness for excluding the water in the quarry; but even although it were as open as gravel, it could still be quarried at an advantage. In that case we would not bank out the sea at all. The plan would be to fill up the channel with sand as fast as excavated, leaving only a

APPENDIX C.

LEITH.

No. 14.

Milne, on extending the Harbour to the east.

few feet clear for the quarriers to quarry down to the required depth, and to sluice the water away from them to a steam-engine. By this method the quarriers would work only a few hours at a tide; and the sand would have to be afterwards removed from the channel. Practical men do not require a minute description of this "sluicing" method, and a detailed description of it would be tedious. It would not be necessary at the Middle Craig; but, if it were, the stone quarried would cost 4s. 6*d*. per yard.

Our eastern harbour would be much more convenient for the existing interests of the town of Leith than Mr. Cubitt's western harbour. It must be obvious that, were his harbour constructed, no vessel would prefer the old shallow harbour to the new deep harbour; and that it would soon be unnecessary to keep the old channel open by *dredging*—a recurring expense which would be greatly increased after the construction of Mr. Cubitt's breakwaters (Report, page 50). A vast deal of house property, &c., would therefore be rendered comparatively useless,—indeed, as useless as if the new harbour were made at Trinity. On the other hand, my proposal would render the old harbour, and the existing interests in Leith, more available than they are at present. *There is not a stone of the old harbour in the wrong place; they form an essential part of my improvement;* and whilst the trade would be continued where it has existed for ages, the inhabitants of Leith would have the guarantee that no additional house property would be built until the excess of trade compelled the overplus shipping to lie in my new basin; at which time an excellent street could be built at Timber Bush, along the shore from the old harbour to Constitution Street, and eastward. This ground belongs to the City of Edinburgh; and by feuing it at a guinea a-foot, that is, at half the feu-duty of the grounds about the present docks, it would bring 1000*l*. per annum to the city. This would be an additional security to the creditors, as it would be made a fund for paying them up, and, in the mean time, enhance the value of their stock. This would be a better mode of doing it than to tax the inhabitants, as is proposed. This, however, is not all the ground rendered available by my plan,—120 acres of dry ground would soon be formed about this harbour, fit for any purpose whatever; but I shall not put a value on it, lest it should be conceived to be as utopian as my anticipations were conceived to be about the deepening of the water of the Middle Craig,—anticipations which, nevertheless, were correct.

It has been objected to my plan that "it would become silted up, both from the sea and from the river, carrying mud through the gateway between the old harbour and the new basin. I have already disposed of the first part of this objection, and I shall now review the second part. The objectors say that "the docks are full of mud, and that, therefore, it must also pass from the old harbour into my new basin." I find no intimation of this fact on record; nevertheless, it may be true to some small extent. No doubt mud will collect in any pool in which vessels are loaded and discharged; and, besides, the muddy river runs into these docks to supply the waste water run out during ebbs and neap tides.

Circumstances, however, are different as regards my intended new basin; *the water in it would always be as high as the water in the new harbour.* There can never, therefore, be a current through the gateway between the old and new basins,—especially when the gates are to be kept shut; and if no current, there can be no silt. But suppose that a little mud shall pass from the old into the new harbour without being carried, objectors will surely admit that there is more to fear in Mr. Cubitt's harbour, as I have shown at pages 12, 13, 14. "But," say they, "we can clean out that harbour by allowing the water of the docks to rush into it." This is absurd. The bottom of that harbour will be at least eight feet below the bottom of the docks; a discharge from the latter cannot, therefore, reach the bottom of the former, nor cause a current in it.

All objections I have heard to my eastern extension of the harbour are of a nature similar to what I have alluded to at different places of this paper, and can be as easily refuted were it necessary. A little attention to facts and principles would render that less needful.

From what I have said in former pages regarding the influence of the tide on silt, and regarding the depth of sand above the clay on Leith Sands, as affecting my estimate of expense, I hope the Commission will endeavour to obtain the necessary information. A knowledge of the direction and force of the tide is of primary importance in the designing of the situation, &c., of the walls at the entrance of any harbour to be built in the vicinity of Leith; yet this essential has never been attended to, so far as I know. No doubt the direction and force of the currents are figured at the middle of the Frith in Thomas's Survey; but these are too far out from the shore to be of use. What I want is a survey of the direction and force between the Eastern group of the Black Rocks to Newhaven Pier,—close in-shore.

These and making borings are of too expensive a nature for a private individual to undertake; and, besides, although he were to do it, his labour would be non-official, and therefore satisfactory to nobody except himself. At any rate, it would be much more satisfactory if done by the Commission;—and, perhaps, it will be recollected that silent Nature can be accommodated in her operations, and made to assist us in ours, but neither thwarted nor confined; and that even after everything has been done in the best way we can, there is still something to fear,—there may be unseen operations in the water which may not be detected; but, by a diligent search at this time, the danger cannot be great.

I am, &c.,

JOHN MILNE.

To the Hon. the Commissioners for Improving
the Harbour of Leith.

NOTE.—After these pages were prepared for publication, I noticed in a report of the proceedings of the Commission, that it is the intention to "offer a premium for plans if that shall be afterwards thought necessary." This renders some of my preliminary observations too late; but I cannot alter them, and perhaps the Commission will see the force of my concluding paragraph. If candidates for the premium are left to make borings, and to ascertain the direction and force of the currents, I cannot see how the Commission can ascertain whether the plans to be proposed are suitable or not.

Appendix C.

Leith.

No. 15.
Cubitt's Second Report on improving the Harbour and Docks.

No. 15.

Second Report by W. Cubitt, Esq., F. R. S., on Leith Harbour and Docks.

Sir, 6, *Great George Street, Westminster, May* 13, 1839.

Adverting to a communication of the 24th December last (25,814$\frac{7}{8}$ $\frac{1}{2}$), addressed to Mr. Walker and myself, calling upon us to inspect the harbour and docks at Leith, and to report jointly our opinion thereon, as to the plan and means best calculated for "securing to the port of Leith the additional accommodation required by the shipping and commercial interest, including the provision of a low-water pier,"—and with reference, also, to two letters between Mr. Walker and myself of the 22nd ult., explanatory of my making this separate communication, I have now the honour of submitting to you, for the information of the Lords Commissioners of her Majesty's Treasury, the following report upon this subject, showing,—

That, in compliance with the instructions above referred to, Mr. Walker and myself proceeded to Edinburgh on the 18th January,—arriving there on the evening of the 21st,—and devoted the following week to the matters, and things referred to our inquiries and consideration, by putting ourselves in communication with the Commissioners of Leith Harbour, making an examination of the same personally, and of the various plans submitted for its improvement; and causing such surveys and soundings, &c., to be made as appeared to us necessary for duly ascertaining the facts requisite to guide us in forming our plans. This duty we confided to Mr. George Buchanan of Edinburgh, civil engineer, assisted by Mr. Dall, the harbour master; and Mr. Walker also sent down a practical man from London to make some borings between Leith docks and Newhaven, and in the vicinity of the present harbour entrance.

We had also before us all the plans and propositions of various kinds for the improvement of this harbour, as contained in the report of the Select Committee of the House of Commons in 1835, together with some subsequent projects and propositions for the same purpose by Mr. Milne and another; but, after a careful consideration of the whole, we concurred so far in opinion that, of all the general plans for the improvement of the port, the two most practicable were either to improve the present harbour by means of its existing entrance, as proposed by Mr. Walker, or to construct a new harbour between the entrance of the present harbour and Newhaven pier, with a sufficiently deep entrance at low water, and to excavate a channel from thence to quays, or low-water piers, or landing places (contiguous to the public road) between Leith and Newhaven, connecting the same with the present harbour and docks of Leith by means of a lock, at the west end of the western dock, should such junction in the first instance be deemed necessary.

Having had the honour to be called upon by the Lords Commissioners of the Admiralty, in the year 1834, to examine into the state of the harbour and docks at Leith, with a view to making it eligible for large steamers and other vessels at all times of the tide, I at that time made a very careful investigation of the whole subject, the result of which is contained in a report to the Admiralty, accompanied by plans of the proposed works, and estimates of the probable expense of carrying them into effect.

Having also, after a lapse of nearly five years, and a frequent recurrence to the subject during the interval, again visited Leith, with a view to the present inquiry, and gone over all the circumstances connected with the improvement of the port for the present trade,—for a larger class of sailing vessels,—for large steam vessels,—for the Fife and Mid Lothian ferries,—and for the fishery trade, so as to have ingress and egress at low water, both to convenient quays or landing places, as well as to the present docks, I can see no method of so well answering all those purposes at so little cost, and which will so soon come into practical use, so as to be available for business long before completion, to the extent and to within the limits as to expense prescribed by our instructions, as a plan on the same principles as that which I had the honour of submitting to the Admiralty in 1834, a modification of which accompanies this report.

The principal features of this plan are its comprehensiveness and extreme simplicity.

The object contemplated is to enclose the whole of the strand or shore between Leith docks and Newhaven pier by means of two plain rubble stone breakwaters,—one projecting from the north-west angle of Leith docks, about 3200 feet in length, and the other from the extreme end of Newhaven pier about 1200 feet in length, converging together to within about 300 feet, so as to form an entrance with 12 feet depth of water at the low-water of ordinary spring tides, and enclosing about 80 acres of water surface at high water.

During the construction of these breakwaters, a channel would be in the course of formation from the place of the proposed entrance to the shore, at a point about one-third of the way from Newhaven pier to Leith docks, where a low-water pier or landing wharf would be erected, and the works be at once available for steamers of all classes, at a low-water pier under cover of an enclosed harbour, at an outlay not exceeding 74,500*l.* and in a space of time not exceeding two years from its commencement, inasmuch as making the breakwaters, dredging the channel to the quay or low-water pier, and building the latter, as well as forming the road leading thereto in connection with Leith and Edinburgh, would all proceed simultaneously without in the slightest degree interfering with each other.

By pursuing this plan, that portion of their Lordships' instructions relative to the "*provision* of a low-water pier" (and which is in fact the accommodation first needed), would be amply and efficiently met, much within the limits of the sum (125,000*l.*) to which the improvements are by the same instructions confined; and the remaining part of the question, as to whether the balance would be better applied, as regards the shipping and commercial interests of Leith, in carrying out this plan by extending the low-water channel along shore to, and into the western dock of Leith, or in completing the extension of the present pier of Leith harbour to the extent of, and round to the Mortella Tower, as recommended in my former report of September, 1834 (and at this time partially carried into effect by the present harbour engineer), is a question that would perhaps be better left to the discretion of the Commissioners of Leith Harbour, after the new western low-water harbour and pier (according to the plans which I have the honour to submit herewith), shall have been made available to the public to the extent above pointed out.

The considerations which induce me so strongly to recommend this plan, after a mature consideration of the subject, are its great simplicity and economy, and the fact that, if gradually carried into effect, or by successive steps or portions at different times, every portion completed will be perfect in itself, as far as it goes, and well worth the money expended upon it; for example,—

APPENDIX C.

LEITH.

No. 15.
Cubitt's Second Report on improving the Harbour and Docks.

I. By making two breakwaters, as shown in the plan, about 80 acres of a still-water harbour, with a depth of from 10 to 12 feet at its entrance at low-water, would be enclosed between Leith docks and Newhaven pier, which would protect the whole line of shore (much of which is Government property) between those two points; all the steam-ferry business to Newhaven pier would be brought under cover of a good harbour and quiet landing in all weather; an ample asylum for boats and vessels of all kinds to resort to, for lying up in, hauling up for repairs, or careening, would thus be provided, together with a safe and secure harbour for the fishing trade, and fishing-boats of all kinds to use with safety in all weathers at Newhaven; and all this at an outlay, if judiciously expended, of not exceeding 62,000*l.*

II. The next step in this mode of improving the port, would be to complete the entrance channel to 12 feet in depth below the low-water from the entrance between the two breakwaters to the shore east of Newhaven, and along the some 15 feet deep in front of the Government property at Annfield and Anchorfield, and to erect a low-water pier, wharf, or landing-place, of not less than 500 feet in length, in front of the said Government property at Annfield, and along the waste ground of Newhaven Links, and from this low-water pier or landing-place, to form a road along the shore to Leith *viâ* Dock Street; and also to Edinburgh *viâ* the new road called "Great Junction Street," clear of all tolls or road imposts (as I am informed); or access will also be had to Edinburgh from the proposed quays, as at present, up "Whale Brae," all which entrance channel, low-water pier, and roads of communication, might be effected for an outlay of 12,500*l.* or thereabouts, making a sum total of 74,500*l.* for the new western harbour above described, and the access to an accommodation of a low-water pier suitable for steamers of the largest class, and for sailing vessels of all kinds to load and discharge cargoes, or to fill up or lighten cargoes, if too deep to enter or leave the docks at Leith, till such time as a western entrance thereto may be effected.

III. To complete this arrangement, the remaining step would be to deepen and dredge out a channel in continuation from the low-water pier to the western end of Leith docks, to 15 feet in depth at low-water, construct another landing-pier or wharf of 500 feet in length, opposite to the end of Dock Street and Great Junction Street, and there make an entrance lock 60 feet in width into the western dock at Leith, by which means the whole of the present harbour of Leith would be connected with the new western entrance and harbour, and the present docks at Leith become common to, and accessible by, both entrances, and by the new entrance at all times of tide, so that the largest vessels which could frequent the docks would never be prevented entering, or be detained from sailing on account of tides,—this third step or stage of the improvement might be executed for a sum not exceeding 50,000*l.*, being in the whole 124,500*l.* for carrying the entire of this amended plan for a western harbour and entrance to Leith docks and harbour into effect.

IV. Should it be deemed of more importance to the shipping and commercial interests of Leith (in case there should not be funds forthcoming or available for the whole), to complete the new weir, or extension of the present eastern pier of Leith harbour to the extent of the Mortella Tower, instead of connecting the new western harbour and entrance with Leith harbour and docks, agreeably with the preceding or third proposition, it could be done, as the great desideratum of a low-water pier would be accomplished by carrying into effect the propositions Nos. 1 and 2.

The expense of completing this eastern pier would be about 20,000*l.*, making, with Nos. 1 and 2 of the western harbour and low-water pier, a total of 94,500*l.*, being still considerably within the limits of the proposed loan, and leaving Leith harbour in a most improved state, and capable of such final improvement, at the least possible expense, either east or west, as experience may point out to be the most expedient.

As regards the question of improving the harbour of Leith, by means of its present entrance, and constructing landing-quays, &c., upon the site of the outer (or Mr. Chapman's) harbour, which would have to be filled up and wharfed round for the purpose, and making an entrance into Leith docks on their north side (according to Mr. Walker's proposition), I see so many objections, as regards both expediency and expense, that, although it may be practicable, I cannot join in recommending its adoption for the following, amongst many other reasons:—

1. The entrance, with a wider and deeper channel than at present, will be more subject to silt up, on account of being the outlet for the Water of Leith, as a great portion of the silt and deposit brought down by that stream (which with a larger entrance will become almost stagnant during the time of flood), will be backed up and settle in the new channel, or in any deep or low-water harbour leading off from it towards the docks, as has been the case in the outer harbour, formed by Mr. Chapman, within the western pier; but which will not be the case as regards a new harbour distinct from, and to the westward of, the Water of Leith, with respect to alluvial deposits from that stream.

2. The new quays, or landing-places, and what should, in fact, comprise the advantages of a low-water pier, whether formed on the raised surface of the present outer harbour, or along the back, or north side of the docks, will not be in so convenient a situation, either as regards goods or passengers, as the landing-quays which I propose to make along the shore between Leith docks and Newhaven, inasmuch as every person, and all goods landed or shipped at the back of the docks, must, of necessity, have to cross the docks to reach the shipping places; whereas, on the western plan, nothing would interfere with the use or privacy of the present docks.

3. The convenience at the back of the docks would be of little or no use to the fishing trade, and very inconvenient to the steam-ferry (Fife and Mid Lothian) business, both of which would be greatly and immediately benefited by the enclosure of the western harbour; and,

4. The expense of thus improving the present harbour, in the first instance, as also the annual cost of its maintenance, will in my judgment be far greater, with less convenience, and its capability of future extension and utility much less, than by enclosing a western harbour with a low-water pier or piers within it, and connecting the same with the present docks and harbour of Leith by means of a lock,—at the same time completing the present entrance to the harbour of Leith to the full extent to which it is fairly capable of being improved by carrying out its pier as far as the Mortella Tower.

I have, &c.,
W. CUBITT.

To the Secretary of the Treasury.

APPENDIX C.

LEITH.

No. 16.
Walker, on the Harbour and Docks.

No. 16.

Report by James Walker, Esq., F. R. S., on Leith Harbour and Docks.

SIR, *London, June* 19, 1839.

I DULY received your letter of the 24th December last, informing me that the Lords of the Treasury, having had imposed upon them the duty of deciding upon the best plan to be adopted for the improvement of the port of Leith, were anxious, in the exercise of the discretion thus vested in them, to avail themselves of the practical advice and assistance of Mr. Cubitt and myself; and, therefore, requesting us to undertake the employment, and proceed to Scotland for the purpose, with the least possible delay.—We were directed to have under our consideration the plans laid before the Select Committee of the House of Commons, and also any proposals on Leith Harbour subsequently made for its improvement, but not to confine ourselves to the consideration of existing plans, as their Lordships' desire was to be furnished with such a plan as would *secure to the port of Leith the additional accommodation required by the shipping and commercial interests, including the provision of a low-water pier;* and, in order to obtain more detailed information as to the nature and extent of the additional accommodation required, we were desired to communicate with the Commissioners of the Harbour on the spot. Our particular attention was called to the limit of expense within which we were called to confine ourselves, in reference to any plan to be proposed to the Board; and as the legislature had limited the authority to their Lordships of postponing the security at present enjoyed by Government over the property at Leith to one hundred and twenty-five thousand pounds, we were informed that any plan of improvement must be projected with reference to an expenditure not exceeding that amount, beyond which the Treasury has no authority nor means of providing for the additional outlay; nor would their Lordships be prepared even to sanction an expenditure to the above amount, unless the benefits to the port and harbour, and to the public, were manifest and proportionate.

In consequence of the above instructions, Mr. Cubitt and I proceeded to Leith in January, and commenced the necessary survey and inquiries. On the 22nd of that month we attended a full meeting of the Commissioners, when most of the gentlemen present gave their opinion of the want of accommodation that was required, and several stated their ideas as to the best mode of giving it. At the same meeting a resolution was passed requesting us to examine the alteration proposed by Mr. Leslie, at the wooden quay in the harbour, for the purpose of affording additional quayage for steam-vessels, and also calling our special attention to the weir at the end of the east pier. During the four following days our attention was devoted to the surveys and examination of the above important matter referred to us. We had also conferences with Captain Dall, the Harbour Master, Mr. Phin, the Secretary, and such other gentlemen as were desirous of expressing their opinions, particularly Mr. Milne, Engineer, from whom we have had several communications, and we also met the Provost and some of the gentlemen belonging to Leith, by invitation, at the then Lord Advocate's.

The surveys, sections, and borings of the ground between Leith and Newhaven were obviously necessary for our ascertaining the quantity and quality, and consequently the cost of the excavations, to form a harbour at that place, but on finding that these had not been taken with the accuracy which was requisite, we instructed Mr. Buchanan, engineer, whose experience in such matters is well known in Scotland, to assist us in the details. The result of some of his surveys we received while in Edinburgh, but their completion, and making the borings, was continued after we left, and was a work of time and labour, to assist in which I sent down Mr. Lee, a person of practical experience in such works, and in whose opinion I had confidence. The whole have been done to our satisfaction.

Mr. Cubitt and I have already reported our opinion, that it is desirable to execute the improvement at the wooden quay as proposed by Mr. Leslie. It now remains that we state our opinions on the principal question, which is by no means an abstract one, but has a limit of expense of 125,000*l.*, and two objects, as expressed in your letter, which, after the general directions before referred to, states, that the *Lords of the Treasury had committed the important duty into our hands, in full confidence that we should be able to recommend to their Lordships such a plan for the improvement of the harbour and docks at Leith* as would justify their Lordships in sanctioning its execution, and enabling them to carry out the intention of the Legislature, *by providing for the preservation and prosperity of the trade of Leith, and by rendering and preserving the security originally granted to the Government available and sufficient.* As we are thus, by our instructions, specially debarred from recommending any plan of which the estimate shall exceed 125,000*l.*, no other reason or apology can be required for my not recommending any plan of the nature designed by Sir John Rennie and Mr. Anderson for the west, or by Mr. Milne for the east of the present harbour, as I consider all of these, however ingenious, quite beyond the limits of expense, but at once refer you to the accompanying designs prepared by me, as being, under the circumstances, so far as respects the situation and general features, but with, perhaps, alterations in the detail, the two designs between which the choice ought, so far as I can judge, to be.

The one, which may be called the *western or Leith and Newhaven* plan, proposes the formation of a harbour between the present harbour and Newhaven, the site recommended by most of the engineers who have been consulted. As respects the general design, the plan may be considered as a modification of the plan Mr. Cubitt formerly prepared, and which is described by the dotted lines thus.......... When we were in Edinburgh I suggested to Mr. Cubitt what appeared to me improvements on his plan, which are now delineated and recommended. They consist principally in not interfering with the Newhaven pier, nor materially with the ground used by the fishermen, by which much expense would be saved. Secondly, in leaving a larger space between the harbour and the present road over the cliffs, to be applied as quay-room, road, and otherwise, which has also the advantage of carrying the harbour in deeper water and lessening the excavations. Thirdly, an alteration in the line and direction of the breakwater is proposed, which will be better understood by reference to the plan itself; and the position of the jetties or berths is considerably varied. The *line* of Mr. Cubitt's western breakwater is adopted without alteration.

The construction of the breakwater I propose also to be with a clay nucleus, and the only alteration in this respect is the introduction by me of one foot of broken stone between the clay and the stone facing or paving, and lessening the inner or harbour slope. The pier-heads are proposed to be built of stone for the safety of vessels entering, and for a capstern and lighthouse.

This plan proposes an entrance two hundred feet wide, brought to twelve feet below low-water (the level of the dock silt), with a cut or canal of the same width up to the berths or south side, in front of which the clear width is proposed to be three hundred and twenty feet, one hundred feet wider than

No. 16.
Walker, on the Harbour and Docks.

Mr. Cubitt's plan, but not, in my opinion, too wide for large steamers. The excavation is supposed partly to be applied to form a road of 50 feet, and a quay of 100 feet in width. Five wooden jetties for steamers, and one slip or inclined way, similar to those constructing at Granton, are proposed. The length of the jetties and slope is two thousand feet, thus affording a spacious frontage.

I have shown by dotted lines the situation for a lock into the docks. In his estimate previously delivered, Mr. Cubitt included the formation of a lock as part of his estimate, 125,000*l.*, but the limit of expenditure appears to me to preclude this, the amount of the works I have described and shown upon the plan, being 120,000*l.* This sum is exclusive of compensation, if any, required for property at or near Newhaven. A large space of the shore is left for the fishing-boats, the owners of which will derive much benefit by the protection of the breakwater.

Having thus done what I thought the best upon the principle of a harbour between Leith and Newhaven (the western plan), I have now to describe what may, I think, be done upon the principle of extending and improving the present harbour, which may be described as the eastern or Leith design, Mr. Cubitt being decidedly of opinion that any attempt at a joint design for extension and improvement. through the present entrance would be fruitless, has been the cause of our Reports being separate. As there are advantages and disadvantages by both plans, I have thought right to consider and prepare a design for each, that both might be brought fully forward in coming to a decision on a matter so very important to the interests of Leith in particular, and I should have preferred Mr. Cubitt's joining me in this, and letting our final recommendation wait the issue of our joint inquiry and estimate.

The plan No. 2 exhibits my idea of the eastern or Leith design; the extent of the present will be easily distinguished from the proposed harbour by reference to the plan No. I.

It will be seen that the entrance is proposed to be extended into 10 feet to 11 feet water at low-water spring tides, which is to be deepened to 12 feet, and a direction nearly north, by compass, is given to it, to protect it from the northerly winds, and to render the access easy. The east pier is proposed to be carried out with a platform upon the same principle as Mr. Chapman's, but of greater strength every way, as the work advances outwards, and with a pier-head of squared stone furnished with a capstern and lighthouse.

On the west side the harbour will be bounded by a breakwater of nearly the same construction as is proposed for the breakwater of the western plan, No. I, the present western breakwater being to be taken down, and at a clear distance of 320 feet from the new breakwater a quay-wall is proposed to be built,—the space between the breakwater and the quay, which will form the new deep-water harbour, being to be excavated to the depth of 12 feet below low-water.

The excavation from this space, and generally, will be applied to raise the ground behind the wall, so as to form a quay 1450 feet long by 100 feet wide, having a slip and a beaching place at the north end, behind which is a road 50 feet wide to communicate with the north quay of the present west dock, —a road parallel to this north quay will lead to the passage between the docks, and by the east end of the east dock into the town. Between the quay and road, as above described, and the present passage of the harbour, will be a space of ground of nearly 20 acres, or 96,800 square yards, the whole of which, the material proposed to be excavated or dredged will not be sufficient to raise to the proper level for yards, &c., but upon which any future dredged material may conveniently be laid, and the ground improved, so that in case of more berths being required, at any distant period, a quay-wall or jetties may be formed on the west side of the present channel, by widening it for a length of 1800 feet, with a wharf and a road behind them, as shown by dotted lines, and described on the plan. Even after this there would still be left a triangular unappropriated space of 12 acres, or 58,080 square yards, to be used as yards or otherwise, as may be requisite.

I have shown, by dotted lines, the situation for a lock from the proposed harbour into the docks, but this forms no part of the estimate; and, should the nature and extent of trade and the funds at any time permit it, it will be worth considering if the lock had not better be made toward the lower end of the proposed harbour or quay above described, by which the new harbour would be converted into a steam dock, with a lock of sufficient depth and width for the largest vessel to pass at low water. In this case the west side of the channel into the present harbour might be deepened, and become an outer harbour. This is prospective, but it is proper so to look in laying down any general plan of improvement, that room may be given for extension afterwards. In the same way I may add, that the top of the western breakwater may be widened, and jetties or a wall formed to make the whole of that side into berths, but it may be long before this is required.

Estimate.

The amount of the estimate of the above-described works, made at the same prices as the western plan, is 122,000*l.*

In addition to the large scale drawings, I have coloured both the designs upon one of the engravings from Messrs. Dall and Leslie's survey, by which they are distinctly brought into comparison, the Leith and Newhaven design being coloured blue, the Leith design red.

Comparison.

On comparing the two designs, the Leith and Newhaven has an advantage in having the deep water nearer the shore than the Leith design, which, in order to get into 10½ feet of water, requires as great an extension from the end of the present pier, as the distance from the shore of the Leith and Newhaven entrance does to get into 11¼ feet. The Leith design has, however, a length of only 330 yards of new pier beyond the end of the present weir to reach the proposed pier-head.

There is a good communication by Great Junction Street to Leith Walk. Both designs have this in common; but the Newhaven end of the western design has also communication by the Newhaven-road, and by the Edinburgh and Newhaven Railway, when formed, for which the eastern design is much less convenient.

The effect of the western or Leith and Newhaven plan upon the property between Leith and Newhaven will be to increase its value for building purposes, particularly towards the Newhaven end, as that end will be the first done, and, being nearest the entrance, will always be the more desirable. For the same reason Leith, particularly the eastern part of it, and the property upon the present harbour, will, to say the least, not be improved by the execution of the western design. I believe that none of the property between Leith and Newhaven, which will thus be improved by the western design, belongs to the Commissioners of the harbour, but some part of it does to the Ordnance or Customs. Generally, it is too high to be conveniently connected as yards or warehouses with the harbour, but will be well situated for dwellings. The connection between the jetties, or wharfs, upon the western

APPENDIX C.

LEITH.

No. 16.
Walker, on the Harbour and Docks.

designs and the present warehouses in Leith, may be conveniently formed by a railway when thought desirable. The amount (125,000*l.*) named by the Treasury, was, I apprehend, formed upon Mr. Cubitt's former plan and estimate of the western site, which may be so far an argument in favour of it; but then a lock, communicating with the docks, was included, which, according to the measurements and prices I have taken, there is no money for.

The approach to the entrance of the harbour of the Leith and Newhaven design is probably less exposed, and the land approach to the quays is more free and uninterrupted than by the Leith plan, which has to cross the west quay of the docks, or one of the bridges.

The entrance is also half a mile higher up the river than the entrance of the Leith or eastern design. This may give it an advantage in respect to the Fife ferries, but I am not sufficiently acquainted with the Fife shore to give a decided opinion on this, as several places upon that side claim to be the best for the ferry station.

So far the balance of advantages appears in favour of the Leith and Newhaven design. In reference to the eastern or Leith plan, it may be stated, that the design is only carrying out and improving the present harbour, which has been in operation with great advantage during the last twenty years.

That the property of Leith, the old harbour and the present approach and entrance to the docks, will be improved by it is evident; and the trade, as well as the attention, superintendence, and expense, be confined to one harbour, and that one the harbour of Leith, in place of two entrances and two harburs, the effect of which may be that one of them will be neglected, or at the best not improved.

The water of Leith acts as a scour in times of freshes, but the mud and rubbish then brought down by it tend to counteract this useful effect, and is an objection in the present harbour, and in any improvement of it, for the deeper and wider the entrance is made, the less will the power of land floods be in carrying the impurities and obstructions out of the harbour. In the schemes, however, which have been proposed for remedying this, I think the evil has been overrated. Mr. Chapman's opinion was that the freshes or speats did more than remove the injurious effects arising from the rubbish thrown into the river. The quantity of rubbish may have increased since Mr. Chapman's time, and, as it is injurious, it should be prevented as much as possible. As the entrance of the harbour is already at or below low-water of spring-tides, the velocity of land floods is so slackened at the ends of the piers, or just outside them, that the matter brought down by the freshes is either deposited in the angles and wide places, or is carried out, and tends to form a bar, and requires to be removed by dredging. I do not, therefore, consider that any deepening can produce an addition of consequence. The places of deposit may, and I think will be, changed, but not the quantity or cost materially; to maintain the depth of entrance and the depth in the harbour, dredging will be required whichever plan may be executed, but the eastern design will require more than the western, taken singly, caused by the difference of the soil and the water of Leith.

The eastern or Leith design gives the means of extension of quayage in the way that has been described to a very great extent, and appears to concentrate and connect the whole of the trade in Leith, and with the present warehouses, more than the western design does—giving, perhaps, at the same time greater security and facility of enclosure.

The large area of ground that will not be required for quayage (from 90 to 100,000 square yards, according to the length of quays required), will be a valuable property, applicable and very convenient for bonding-yards, or other similar purposes, and the whole belonging to the Commissioners. The opportunity of converting the whole or part of the new harbour into a dock, as described in the Report, is peculiar to the eastern or Leith plan.

At present vessels of any considerable draught of water have either to unload part of their cargo in the roads, or to wait the return of spring-tides, before they can enter the harbour or docks; this is, indeed, the great evil of the harbour, there being occasionally at the high-water of neap-tides not more than 9 feet upon the bar. Whenever a lock shall be made between the Leith and Newhaven harbour (supposing that design executed) and the present docks, the above evil will be remedied, and ships of any burden that can enter the docks will be able to do so through the harbour, without waiting or breaking bulk; but until the lock shall be made, the Leith or eastern plan has the advantage, as such ships, after unloading part of their cargoes at the new deep-water quays, in the proposed harbour, may pass with comparative facility into the docks, through the present lock, without going out into the Frith, which they would be obliged to do, if they were wished to go into the dock after lightening in the Leith and Newhaven harbour,—and that the formation of this harbour with the lock, would throw the present harbour completely into the back ground, except for small vessels, is, I think, very evident.

In judging of the two designs, some weight will, under the circumstances, be attached to the design of which the estimate can be supposed the more correct. Now where so great a quantity of the work is to be in the tideway, and under low-water in both plans, contingencies, notwithstanding every attempt to guard against them, may be expected, even perhaps exceeding the difference between the estimates (which do not include contingencies) and our limit of expenditure.

If in the eastern design the contingencies were even the greater, the value of the unappropriated land would be more than a set-off. The quay-walls, according to the Leith design, will be troublesome to found, increased by the depth of sand over the clay; and I consider that the stoning, according to the Leith design, will be more difficult of execution than the Leith and Newhaven; but on the whole I consider the Leith as likely to be correct in point of estimate as the Leith and Newhaven design, caused in a great measure by the extreme hardness or toughness of the clay of which the whole of the excavation of the latter is composed, while a great proportion of the eastern excavation would be sand. I have a high opinion of Mr. Cubitt's practical knowledge, and he speaks very confidently on the point; but for this, I should have had very serious doubts of the practicability of dredging the clay, even at the rate I have put it, which is 1*s.* 6*d.* per yard, or 50 per cent. above Mr. Cubitt's estimate. Other opinions may be given, and even tenders delivered at a lower prics than I have put it. When the work comes to be done, the proof will be afforded. There is also, from the greater quantity of clay in the western site, and the general nature of the ground round it, more probability of large stone, and even rock.

Distances.[*]

The distances, measured from the middle of Leith and Newhaven line of quay, or road on the middle of the new quay, upon the Leith design, to opposite the Register Office, Edinburgh, by Great Junction Street and Leith Walk, are as nearly as possible the same. By Newhaven, the distance is

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[*] These distances are not from measurement, but from a small engraving of Edinburgh and Leith.

APPENDIX C.

LEITH.

No. 16.
Walker, on the Harbour and Docks.

increased according to either plan; but of course greater by the Leith than by the Leith and Newhaven plan.

Of the two designs, then, which on the whole has the balance in its favour?

I have stated what appear to me the comparative advantages of both, and the Lords of the Treasury will be able to draw their own conclusion.

My opinion is, that if the question is confined to steam-packet accommodation, chiefly for passengers, the Leith and Newhaven design is preferable; but that for Leith, and the accommodation of its commercial and shipping interest, with the improvements of its harbour and docks, which are stated to us as important points for consideration, the advantage is in favour of the eastern or Leith plan, which is also provided with a low-water pier.

In considering the comparative importance of the two objects, passengers and goods, and the probable continuance or increase of both trades, the extension of railways, and their effect upon the trade of passengers, is not to be overlooked. Already, when there is railway conveyance for only half the distance, a falling off in London steam passengers is stated to be felt, but that this is compensated to the packets by an increase of goods, which has been gradual for several years. A continuous railway from London to Edinburgh will probably throw the balance, as respects passengers, much more in favour of the land passage, which, when a good line comes to be made, will be done in half the time of the best passage by water, while for goods not requiring dispatch, the water conveyance is, and probably will be, cheaper than the railway.

I am, &c.,
J. WALKER.

To F. T. Baring, Esq., Secretary to the Treasury.

No. 17.

No. 17.
Milne's Second Report on extending the Harbour to the east.

Second Report by JOHN MILNE, Esq., *on extending Leith Harbour towards the East.*

Edinburgh, November, 1839.

SIR,

IN compliance with your request, I shall now give you "a comparative view of the expense, &c. of my proposed improvements on Leith Harbour, and of Mr. Cubitt's or Walker's, with an account of the circumstances which enable me to propose the execution of my scheme at a sum so much below the Parliamentary allowance."

After having made out these plans, and calculated their expense, according to my own knowledge of the subject, I applied to other practical men for their opinion on the accuracy of my views, and was glad to find that, on all points or items of expense, on which their practice enabled them to speak, they were satisfied that I had not underrated the works proposed; and at this time I could have very easily obtained an offer of contract from respectable parties, but I declined it, for the following reasons,—

First,—In some instances it has been unjustly alleged that an engineer has vamped up a plan, specification, and estimate, and obtained a preliminary offer from contractors, and that afterwards, when his plan was adopted, he altered the plan, or else the specification, so as to make the offer no longer binding. I concluded, therefore, that I ought not to run the risk even of a suspicion that such was my intention.

Second,—It also happens that, on a respectable contractor being applied to for a preliminary offer, he almost invariably makes his estimate 25 per cent. higher than what he is willing to take for the work, because he knows that if the amount of his preliminary offer shall be made public, some of his brethren in the trade will offer below him, when the real offer of contract shall be called in; he therefore gives himself plenty of room to descend below the ideas of persons less honest than himself; and on this account I declined to take the risk of obtaining an estimate likely to be 20,000*l.* above what is sufficient to cover the expense of my proposal.

Third,—When I had made out these plans, and satisfied myself of the expense of their execution, I had a hope that the Commissioners for the harbour and docks would,—as is usual in similar cases,—investigate their merits in every respect, by taking the evidence of persons able to give a reason for their opinion on every point. In this hope, however, I have been disappointed.

I am, therefore, not prepared at this moment to lay before you all the evidence I could wish, but shall do so as soon as I can collect it.

In the meantime, I can only refer to the evidence taken before the Parliamentary Committee,—to the plans of Messrs. Walker and Cubitt,—to my own plans as published, and to the price of stone and carriage from all the quarries from which material can be brought to Leith, &c. &c.; the accuracy of all which you can easily test by applying to the proper persons.

I have never heard any feasible objection to my plans, except that I have *underrated* the expense of their execution. I shall, therefore, now show how far the allegation is true, by a comparison of my rates with those of other persons, &c. And this comparison shall be made only between Mr. Walker's modification of Cubitt's Western Harbour,—the one recommended by the Commissioners for the harbour,—and shall give a reason for this selection before I close this letter.

Price of stone at the different quarries, and expense of land and water carriage from each :—

Ashlar fit for Breakwater Facings.

Craigleith,	per cubic yard,	£1	7	0	Carriage,	£0	5	1
Dallachy, Fifeshire,	do.	0	11	3	do.	0	2	3
Graing, do.	do.	0	13	6	do.	0	2	3
Inverkeithing, do.	do.	0	13	3	do.	0	3	0

Packing fit for Breakwaters.

Craigleith,	per cubic yard,	£0	1	6	Carriage,	£0	3	6
Dallachy,	do.	0	0	11	do.	0	2	3
Graing,	do.	0	0	11	do.	0	2	3
Inverkeithing,	do.	0	0	0	do.	0	0	0

These prices of stone are what are usually paid at the quarries; but on a large contract, such as that for the intended improvements at Leith, there can be no doubt that the proprietors of any one of the quarries would engage to furnish the stone at a less price. The carriage, however, cannot be

APPENDIX C.
LEITH.
No. 17.
Milne's Second Report on extending the Harbour to the east.

reduced, except by means of a railway from Craigleith to Leith, as is proposed by Mr. Anderson at page 202 of the Parliamentary Report, where it is stated, in Mr. Johnston's letter, that a saving of carriage on Mr Anderson's material would be effected, by means of a railway, to the extent of 12,625*l.* My proposal, however, is to do without the railway, and to secure all this saving, as well as the cost of the stone, by finding it at the Middle Craig.

In the above tables it will be seen that the land and water carriage from Fife amounts to about one-fifth of the value of the Ashlar facing; and that on the packing it is more than double its cost at the quarry. Any proposal, therefore, to find stone at Leith must be the cheapest accordingly. I do not think it possible to bring stone by water cheaper than at the above rates. I was for some time an agent for one of the Fife quarries, and had ample opportunity of ascertaining what freightage was paid; and the carriage of the last stone I brought from Fife to Fisherrow cost 4*s.* 6*d.* per yard, including delivery of the vessel. Hence I conclude, that the rates in the above tables are only those which, at the lowest, a contractor could bring stone to Leith by purchasing vessels for his own use.

I am now to compare Mr. Walker's modification of Mr. Cubitt's breakwaters with what I propose in my published plan, No 4, allowing in both cases the same price as stated in my published estimate, which are said to be "too low."

Here, however, I meet with some difficulty. Messrs. Walker and Cubitt have given neither sections, dimensions, nor specifications of the works now proposed by them,—nothing but the sum total which they conceive sufficient to cover the expense of their proposals. I must therefore go back to the first Report of Mr. Cubitt,—to the "Appendix to Report from Select Committee," page 182, where you will find a section and specification of Mr. Cubitt's breakwaters, as formerly designed; and by measuring the present modification of that plan by Mr. Walker, you will see that it is intended to be as broad as in the section attached to Mr. Cubitt's Report, already quoted; and by applying the compass to the new modification of the breakwaters, you will find that the eastern one is 3650 feet long,—that is, 450 feet longer than before,—and that the new western breakwater is now 1450 feet, or 250 feet longer than before,—that is, the sum of elongation is 700 feet. At page 18, however, of Messrs. Walker and Cubitt's new Report it is implied that no such extension of the breakwaters is intended, nevertheless I conceive that the text is wrong, and the engraving right, as it carries the breakwaters out to the depth of water intended by Mr. Walker.

Breakwater Facings

of Mr. Walker's modification of Mr. Cubitt's Western Harbour, at my published rates of prices.

First* portion of Eastern Breakwater, 2000 feet long, × 100 feet broad over top, ÷ 9 =	22,222 up. yds.	
Second portion of do. 1200 feet long, × 100 feet over top, ÷ 9 =	13,333	
Western Breakwater, 1200 feet long, × 100 feet broad over top, ÷ 9 =	13,333	
Number of yards as calculated by Mr. Cubitt in his Report	48,888	
Length now added to the breakwaters, as shown above, 700 feet, × 100 over top, ÷ 9 =	7,777	
	56,665	
Superficial yards required for Mr. Walker's modification of Mr. Cubitt's breakwaters, which at the same rate as my own on the Rocks,—that is, at 12*s.* per yard for mason workmanship, 1*s.* 6*d.* for quarrying, and 9*d.* for carriage on the railway proposed by me,—that is, at 14*s.* 3*d.* per yard,		£40,373 16 0

Packing.

Rubble basis as at first designed by Mr. Cubitt—

Eastern Breakwater.

First length.—Cubic feet,	434,000	
Second Ditto, ditto,	904,800	

Western Breakwater.

Whole length, 1200 feet, × 10 feet thickness, × 45 feet breadth, being the average thickness allowed by Mr. Cubitt for his Eastern Breakwater,	540,000	
Required additional by extending the breakwaters 700, as in the new plan, 700 × 13, × 58,	527,800	
To which add small stones 1 foot thick, as now proposed to be put above the clay nucleus, as described at page 18 of the new Report of Mr. Walker.—Length, 5100 feet × 100 over top =	610,000	
Cubic feet,	2,916,600	
27 = 108,022 cubic yards, which at my price, 1*s.* 6*d.* per yard for quarrying, and 9*d.* for driving, or at 2*s.* 3*d.* each,		12,152 9 0
		£52,526 5 0
Expense of the new Western Breakwaters at my rates, which do not include land and water carriage, because my plan does not require it, but which is indispensable for the Western Harbour,		£52,526 5 0

Therefore,

Facings as above,	56,665 cubic yards,	
Packing, as above,	108,022	
Cubic yards	164,687	
Which, at 2*s.* 3*d.* each, as in the foregoing Table of Rates of water-carriage,		18,527 6 0
Carried forward		£71,053 11 0

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* Appendix, p. 182.

APPENDIX C.

LEITH.

No. 17.

Milne's Second Report on extending the Harbour to the east.

Brought forward . . .	£71,053	11	0
Total expense of the new Western Breakwaters at my rates,—no allowance being made for the clay nucleus. It might, however, be a fair comparison to make these breakwaters as substantial as my own, by packing them with stone, instead of clay as designed. Now in Mr. Gibb's estimate, at page 18 of Parliamentary Report, you will see that it requires 255,288 yards of packing to complete the breakwaters proposed by Mr. Cubitt; and as they have now been made 700 feet longer, 44,884 yards additional is required accordingly, or in all, 300,172 yards of packing, which, at 1*s.* 6*d.* for quarrying, as allowed by me, and 2*s.* 3*d.* for water carriage, or at 3*s.* 9*d.* per yard, ...	56,282	5	0
Expense by making the Western Breakwaters as substantial as mine, . . .	£127,335	16	0
Expense of my Breakwaters and Mounds of Plan No. 4, as estimated by me, .	£32,794	0	0

In my published Estimate it is stated that the facings are to be "six feet thick, laid in mortar," but read, three feet in mortar, and three feet built dry, in the usual way.

By this comparison we see the advantage I have from the height of the sands and rock, and from my requiring no carriage, which enables me to complete my breakwaters at comparatively little expense, and that although my lines are carried out somewhat farther from the shore than those of the Western Harbour, this is of little consequence compared with the increased depth outward, and consequently the great breadth of building required for the Western Harbour.

Expense of Mr. Walker's modification of Mr. Cubitt's breakwaters, as estimated by Mr. John Gibb, Contractor, Aberdeen:—

Facings as above, 56,665 cubic yards, at 14*s.* 7½*d.*	£41,436	11	0
Packing 108,022, &c., at 4*s.* 6*d.*	24,304	19	0
Total expense at the rates declared by Mr. Gibb to be sufficient, . . .	65,741	10	0
Total expense according to the rates I have allowed for my plan, as above, .	71,053	11	0
Excess of my rates over those of Mr. Gibb, ...	£5,312	1	0

Nevertheless I am said to have made my rates "too low."

Expense of my breakwaters, and forming to the beach, according to the rates of Mr. Gibb:—

Facings on my breakwaters, as in my published Report,—39.399 yards at 14*s.* 7½*d.*	£28,810	10	0
Packing in all my breakwaters, and mounds to the beach, 108,022 yards at 3*s.* 6*d.*[*]	18,903	17	0
Total expense of my breakwaters, as estimated by Mr. Gibb, which, however, includes carriage I do not require, as I find stone on the spot, ...	£47,714	14	0
Therefore, 147,421 cubic yards, at 2*s.* 3*d.* each, as in the foregoing table of expense of carriage, ...	16,584	17	0
Expense of my breakwaters, as estimated by Mr. Gibb, ...	31,129	17	0
Do., as estimated by me, as above, ...	32,794	0	0
Excess of my estimate over that of Mr. Gibb	£1,664	3	0

And this by supposing that his high-priced description of work (which, he says, is applicable to the Trinity breakwater, and to Mr. Cubitt's in deep water) is also the proper price for all mine; much, however, of which is in still water, as in my breakwater between the Outer and Inner Harbours, and between the rock and the beach, where there is never more than eight feet water, and where a lighter and cheaper sort of work would be good enough for the purpose.

This estimate of Mr. Gibb, to which I have referred, will be found at page 18 of the Parliamentary Report; an estimate which he prepared to show that Mr. Cubitt had underrated his project, and what he declares was his rates for the great breakwater intended at Trinity;—nevertheless I am above him, even for work all above water.

I shall not compare the price of my wharfage or low-water piers. This would depend upon the extent of accommodation to be formed. My published estimate includes 1000 feet of low-water pier and 750 feet of deep wharfage, which, however, is 700 feet more than Mr. Cubitt, and 300 less than Mr. Walker. Their landings are constructed of wood, mine are of stone. A comparison is, therefore, impossible; but mine can be extended at any time, at the expense of workmanship alone, as the stone is to be laid down along the lines in all directions, and this is already provided for and included in my published estimate.

As already noticed, Mr. Walker proposes to modify the plan of Mr. Cubitt, by extending his breakwater-work 700 feet, and by making double the extent of low-water piers and wharfs, and to make the ship channel 100 feet wider, and the dredging at 6*d.* a-yard more than Mr. Cubitt; whilst his total estimate is less than that of Mr. Cubitt. In lieu of these additions Mr. Walker omits an entrance into the docks, and thus prevents them from being of any more use than at present, and thus also cuts off all communication between the old harbour and the western.

My estimate of 1*s.* per yard for excavating the clay from the ship channel, has been objected to as insufficient.

Mr. Cubitt estimated his excavation at the same rate, and said, in evidence before the Select Committee, that he had got similar work performed for half the sum. See Report, page 126.

Some persons have said that, as Mr. Chapman's breakwater cost 28,000*l.*, mine must at the same rate cost 300,000*l.* This is altogether a fallacious comparison; not more than 7000*l.* of this sum went into the pockets of masons and quarriers. The remainder was absorbed in the price of stone, its carriage (see table of rates of carriage), for timber, carpenters' wages, bolts, copper, &c., none of which are required for my breakwaters. The comparison is, therefore, altogether inapplicable.

I have already endeavoured to point out the great advantage of finding stone at the Middle Craig.

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[*] This is the price for packing above water; for deep-sea building, he makes it 4*s.* 6*d.*

APPENDIX C.

LEITH.

No. 17.

Milne's Second Report on extending the Harbour to the east.

The small quantity of quarrying and building required, and all above water, is of itself a great inducement to adopt this plan, whilst the saving of all carriage makes it evident that, even although banking out the sea were to cost 30,000*l.*, the scheme would still compete with any other proposed. Banking out the sea, however, is not a difficult matter, except to persons who have had no experience in this way. I have sent my plan of quarrying, which I hope you will understand. The breakwaters form the embanking,—being made impervious to the entrance of water by a water-tight septum of Elgin mortar and stone shivers all along their middles,—that is, all round the rock to be excavated. This mortar sets, or turns hard, even below water, in course of a few minutes, and soon becomes as hard and impervious as its native rock; and whilst the excavation is going on, a coffer of ashlar stone, of the same strength as the breakwaters, is to be formed at the entrance of the channel. These temporary breakwaters, or coffers, are also to be made impervious to water by means of the mortar pulp nucleus, already described, and when the excavation shall have been completed, these temporary ashlar cofferings are to be taken down and built up into the piers,—hence their expense, as cofferdams, would be for the mere workmanship only of putting them up.

The expense of the whole water-tight nucleus and ashlar coffering, therefore, is below 3000*l.*; and I have been at much pains in ascertaining this fact. It is already included in my published estimate.

No doubt, much water would still percolate through the rock, from below the foundations of the impervious breakwaters; but, from my "Quarrying Plan," you will see that the greater part can be sluiced off, twice every day, when the tide is low, and that by employing a steam-engine of ten-horse power, 560 tons of water could be pumped every hour.

You will observe, too, that by working out the stone, by forming separate pits, in the way I propose, the quarriers can never be brought to a stand by the accumulation of water in the excavation, either by percolation, or by dashing over the tops of the breakwater in a storm;—if this should happen, the engine is made to pump from one pit only, and the quarriers can work there until low-water, when the water, dashed into the general excavation, would be sluiced off at low-water. The breakwaters and temporary erection on their tops is 14 feet above high-water. Every quarry of this magnitude requires to be pumped, and the expense depends as much upon the height to which the water is raised, as upon the quantity to be discharged. At Craigleith the water appears to be raised fully 100 feet; at the Middle Craig it would have to be raised on an average only 20 feet; we could therefore pump five times as much water at the same expense as at Craigleith quarry.

There is nothing new in my plan of quarrying; on the contrary, what I propose is only what is done at every quarry where there is much water; and I am of opinion, that there is not an experienced quarrier in Scotland who would not readily undertake the work,—except, indeed, those quarriers in the vicinity of Edinburgh, who fear my proposal of finding stone in this way, as it would deprive them of a good contract for the intended western harbour.

By turning to paragraphs 430 and 577 of Parliamentary Report, you will see that Mr. Gibb intended to render his outer walls water-tight, so as to exclude the sea, and so get at the inside of the docks to build them. That experienced engineer and builder was not afraid to trust to a clay nucleus in water,—average twice as deep as at the place my impervious walls would be required, and where, accordingly, the water would be only half as difficult to keep out.

I have, along with this, sent a statement by the factor for Peterhead Harbour, of the quantity of the granite excavated from that harbour, and you will find further particulars, by reading page 100 of the "Ninth Report of the Commissioners for Highland Roads, Bridges, and Harbours," which I have also sent. In Mr. Gray's letter you will see that the excavation at Peterhead cost only between 1*s.* 6*d.* and 2*s.* 6*d.* per yard. At Troon Harbour it cost 1*s.* 6*d.* a-yard, indicating thereby, that stone for the harbour at Leith could be obtained at the Middle Craig at a cost not exceeding what would have to be paid for carriage alone.

Troon Harbour and Docks are excavated in a peninsular rock, which projects 6500 feet into the sea; our Middle Craig is only 3000 from Leith. It is difficult, therefore, to conceive why this plan is not preferred, especially as its execution would ensure permanency of depth of water by natural means, and retain the trade of the old harbour of Leith at its present place, and be more convenient as regards the distance of its landings than any of the other schemes proposed. It is about a quarter of a mile nearer to Edinburgh than any of them.

On one of the plates attached to the report of "Highland Roads," &c., you will see represented a a great many harbours built upon, and excavated in rock. Indeed, Mr. Telford seems to have always selected such a site when possible,—probably because it saved expense, and offered a better foundation than sand.

I have omitted to make any comparison between my plan and that of Mr. Walker's Eastern proposal, because I think that the less that is said about it the better. I have always contended that much sand comes down the river,—and that all the stuff that ever choked up the channel of the harbour was originally the produce of the river,—that on certain occasions, the bar, or delta, formed at the Middle Craig, was driven back into the harbour, and that, again, this was in part taken away by the floods of the river. This is questioned. On the contrary, it is alleged that "little or no sand comes down the river;" but at paragraph 597 of the Parliamentary Report it is stated by Mr. Jardine, that he knows "that great quantities of gravel and sand and mud are carried down from the higher parts of the river every flood," and in the course of last week I had occasion to travel up the banks to Juniper Green, about seven miles above Leith. Much of the banks of this portion of the river consists of rock and shale, and perhaps an equal portion consists of clay, gravel, and sand.

These portions are deeply indented by the water, and at some places where attempts have been made to embank by building, the masonry has been swept away.

At present much sand lies on the flat meadows on the edges of the banks, and this sand lies at some of these parts about eight feet above the bed of the river, proving thereby that the quantity of silt taken down in the natural channel of the river must be occasionally very great.

Some of the millers near Juniper Green told me, that occasionally the river swept away every thing,—mud, sand, gravel, large boulder stones, fences, and bridges; and one of them showed me the spot on which he had lately a potato-field, which has been swept away,—earth and potatoes, all to the bare rock. Other persons corroborated this evidence; and said that, farther up the river, the banks were in a worse condition, and that every furrow in the ploughed land pours its sand into the Leith.

APPENDIX C.

LEITH.

No. 17.
Milne's Second Report on extending the Harbour to the east.

A sufficient number of borings have not been made between the Middle Craig and the beach, to enable me to say whether that space contains sand and clay only, or rock,—if it contains much rock, that would be an end to my proposal.

I am, &c.,
JOHN MILNE.

Archibald Thomson, Esq.,
Chairman of the Edinburgh Merchant Company Committee on Leith Harbour.

Raith Quarry, Fifeshire, November 6, 1839.

SIR,

AT your request, I have this day examined the Middle Craig Rock, with reference to the practicability of excavating an entrance channel through it to the harbour of Leith,—and, having also examined your "Quarrying Plan," I have no hesitation in saying that your proposal is not only practicable, but very economical, if carried into effect.

I would readily undertake the excavation at the price per yard allowed in your published estimate, being confident that your method of preventing the accumulation of water renders the quarrying as easy as in any other quarry, and defeat impossible.

The sea would percolate very little through the rock, below your impervious breakwaters, as I see pools of water on the rock at low-water, which could not be there if the rock were porous, so as to allow the water to run away.

The rock is excellent free-stone, fit for pier purposes. I have now had thirty years' experience in quarrying in Fife and Perth shires, and would engage to effect your excavation as readily as in any quarry in them.

We pay 7*s*. 6*d*. per yard of freightage for our whinstone, sent to Leith from Kilkaldy, besides other charges.

I am, &c.,
ALEX. BRUCE, *Quarrier.*

I shall send more evidence as soon as possible.—J. M.

No. 18.

No. 18.
Napier, on improving Leith West Wet Docks.

Proposal by Mr. J. NAPIER, *for the Improvement of Leith West Wet Dock, &c.*

Edinburgh, Nov. 1844.

THE want of a sufficient deep-water harbour, and low-water pier at Leith, has ever been the greatest detriment to the prosperity of the port, and has been severely felt by her active and enterprising merchants and ship-owners as a strong drawback, cramping their own energies at home, and compelling foreign traders to proceed to a more safe and convenient, and latterly we may add, to a more economical harbour. Various plans have been suggested to remedy, as far as possible, the want of a low-water entrance, and of a sufficient depth of water for larger vessels lying in dock; but after the vast amount of money that has been expended in carrying out the various improvements adopted from time to time, comparatively little good has been obtained; and it is greatly to be feared that unless some better accommodation can yet be found for steam boats, and vessels requiring more depth of water, Leith harbour will soon be deserted,—her docks, at present only about half filled, will be left wholly empty,—and her spacious quays and warehouses rendered useless;—the rich and extensive feus in the neighbourhood of Junction-street and the wet docks will become valueless; and her merchants and brokers, at last, reluctantly compelled to shut up their warehouses and offices, and sue for permission to share in the advantages which they have allowed to accumulate and get settled down at Granton.

In submitting the following plans for erecting a new low-water pier, and improving the present docks, it is not necessary to enter on the merits of the question, as to the superiority or utility of the new harbours and docks proposed to be erected either to the westward or eastward of the present docks, but to show how the present accommodations and erections may be rendered available for our trade, which within the last 30 years has so greatly changed, and for which no corresponding alteration has been made in the shape of entrance for steam vessels, &c.; and that too at a very small cost, compared with those other plans, while the whole improvements now proposed might be carried through in the space of 12 or 18 months, without interfering or interrupting the present entrance for a single day,—both it and the eastern dock, which afford sufficient accommodation for the smaller craft, remaining as they are.

The first plan we propose is,—1. To have at all times 20 or 21 feet of water in the western dock, instead of 14 feet, the present average; by conveying a supply of fresh water from the dam-head at the saw mills, which is of an elevation sufficient to fill the dock to the very lip;—2. To close up the present eastern entrance to the westernmost dock altogether, and make a new entrance, with a lock of a sufficient size, in the centre of the bastion at the north-west corner;—3. To erect a steam-boat pier at the outside entrance to the lock;—and 4, To scoop out a fair-way of sufficient width and depth to the nearest depth of 12 feet water, at low tide, as shown in my plan.

In the second plan, we propose to underfit the walls of the present western dock 12 feet below the present depth, and excavate the dock to that extent, having an entrance by a common gate, or gates, instead of a lock, as in the first plan, making the sill of the dock level with the fairway, and thus securing at ordinary tides a depth of 26 feet, and at spring tides, 29 or 30 feet, which would be sufficient draft for the largest merchantmen, or war ships of a certain class. This plan would certainly cost more expense than the first; but we conceive that it would be no ways dangerous or difficult, as there is no weight of warehouses resting on the wall; and the alteration might be carried on at four different points at the same time.

Were these improvements carried into immediate effect, the hindrances so much complained of would in a great measure, if not altogether, be done away with. Nine tenths of the vessels belonging to, or trading with, Leith, are under 100 tons; and if 12 feet water could be secured at low water, and 20

APPENDIX C.

LEITH.

No. 18.
Napier, on improving Leith West Wet Docks.

to 30 feet at high water, it would not only accommodate all the steamers but be the means of inducing other trade to the port, which is now kept away by the insufficiency of the harbour and docks.

Many circumstances combine, at the present time, in favour of either plans; such as the present extent of Granton pier, which will almost, if not entirely prevent a deposit from the west, as the new pier with breakwater will do on the east; thus making the space for the new entrance (which will be very little farther than the end of the present pier, in a north-west direction), comparatively smooth water out to 12 feet at low tide: the cut, too, for the lock or gate through the bastion, will supply a number of stones from the inside and outside walls, which will go far to line up the inside; and the present state of Great Junction-street is also favourable for bringing down the fresh water, if the first plan proposed should be preferred.

Some notion of the expense of dredging or excavating the fairway, may be obtained by comparing the estimates drawn out by Mr. Cubitt, in his report as to the harbour and docks of Leith He says the costs of an "Entrance channel, 1500 feet long, 150 feet wide at the bottom, with slopes 3 to 1, 10 feet of stuff to be dredged out at one end, and two feet at the other, 56,880 cube yards at 1*s.*, would be 2,344*l.* Now, we compute that the length of the fairway or entrance from the bastion to 12 feet water at low tide, by this nearest cut, is about 3000 feet, requiring a dredging from 1 to 12 feet, which would cost just about double that sum.

Mr. Cubitt computes the entire estimate of the probable expense of making his proposed improvements at 125,000*l.* and adds: "but even if it were to cost 150,000*l* I should deem its advantages cheaply purchased, compared with spending double the sum of money in the construction of new harbours, distinct from all conveniences and works, which could only lead to the ruin of Leith harbour and docks." Now, if either of the plans submitted can be done for about a tenth of that sum, and yet serve all the purposes required, the inhabitants of Leith, and others interested in the prosperity of the port, are surely called on to adopt means to test the feasibility of these plans, in the first place; and, if found worthy of consideration, and to take farther steps to forward these improvements, with as much haste as the urgency of the case demands.

J. NAPIER.

No. 19.
Petition of Edinburgh and Dundee Steam Packet Company.

No. 19.

To the Honourable the Board of Trade. *The Petition of the Edinburgh and Dundee Steam Packet Company.*

HUMBLY SHEWETH, *April*, 1845.

That your Petitioners are greatly overcharged, and their trade oppressed by the heavy northern lights charged them, regardless of the Act of Parliament, which exempts shipping from payment of lights which they do not pass nor derive benefit from. That your Petitioners sailing their vessels one passage every day in Winter, and to and from Dundee every day in Summer months—five months of the year—the overcharges made on them are most enormous in comparison to their trade; all the above passages being made in day-light, betwixt 10 A.M. and 4 P.M., in Winter; and betwixt 7 A.M. and 8 P.M., in Summer,—it may be said they derive no benefit from lights at any time—but they are charged 1*d.* per ton (8*s.* 6*d.* on the Benledi, and 17*s.* on the Britannia) for the Bell Rock Lights, which they derive no benefit from and do not pass—this Bell Rock being quite out of their course, and 14 miles distant from it; it is even impossible that a steamer can ever be driven near it, on the Edinburgh and Dundee passage,—as a westerly wind is a land wind, and always smooth water on this track.

The whole lights charged on a steamer going from Edinburgh to Dundee cost as much as her coaling: 2*d.* per ton Northern Lights, and 4*d.* for Isle of May Low Light; and 1½*d.* per ton, Tay Lights, make on the Benledi, a small iron boat—27*s.* 5½*d.*—while her coal, at 8*s.* per ton, is only 28*s.* The Tay Lights are not charged returning to Leith.

In one year, 30 weeks, one passage per day is	£191	1	3
———— 22 ——— double runs	181	10	0
For one small steamer, is	£372	11	3

The Britannia, not yet registered, is about 207 tons, or double that of the Benledi; but this enormous charge would draw from one small steam packet company, with only two vessels, which never see their lights, 372*l.* 11*s.* 3*d.*, and 745*l.* 2*s.* 6*d.*=1117*l.* 13*s.* 9*d.*—enough alone to uphold and maintain nearly all the lights named, certainly enough to maintain any one of them.

For several years these lights were compounded by rating the Benledi at 49 tons; when, affecting to have made a mistake, the collectors brought forward claims for arrears. With much difficulty the Tay Lights were paid—but failing in an attempt to compromise the Northern Light ones, Mr. Grieg, the proprietor of the Benledi, now the property of this company, was forced to sell his property and driven into the Gazette.

The cheap mode of conveyance afforded by steam to the population of Edinburgh and Dundee, and their vicinity, connected by business but separated by two arms of the sea—populations of 250,000 and 100,000, ought to have the same facilities enjoyed by similar populations in the west of Scotland. The steamers betwixt Glasgow and Rothesay, Ardrossan, Ayr, Greenock, Inverary, &c. &c. pass within musket-shot of the Bowling and Garmoyle River Lights, and the Clock and Toward Lights, without paying one farthing, while sailing vessels, as supposed to beat about and require lights, are charged for Clock and Toward lights when they pass them: say, to Rothesay. Such charges as are exacted on the east side, retrospectively exacted on the west side for ten years back only, would swallow up all the steamers now afloat on the river and firth of Clyde, would totally swamp all the steam-packet proprietors of the Clyde; it operates not only as a deprivation of a cheap mode—the cheapest mode existing—of communication betwixt the great and important populations of Edinburgh and Dundee, but as a discouragement to the art of steam-boat building at Leith and Dundee—an important branch of industry in Glasgow, Greenock, Port Glasgow, Dumbarton, and Paisley—important too in a national point of view.

That your Petitioners and others applied to your Honourable Board, through the General Association of Steam Proprietors in London, and a modification as to English lights was got in several instances; but as to Northern lights no redress was got, the Commissioners of Northern Lights not having reported to your Honourable Board.

APPENDIX C.

LEITH.

No. 19.
Petition of Edinburgh and Dundee Steam Packet Company.

That large steamers making long voyages may be retarded and derive benefit from lights, but small steamers going short distances at regular hours, full or not full, always in day-light, going over the same ground 400 or 440 times a year, with a cargo of the tenth part of their registered tonnage, at a low freight of 7*s*., 8*s*., or 10*s*. a ton, should not be expected to pay as much per ton as an East or West Indiaman, making one, or at most two arrivals in a year, with a cargo exceeding their registered tonnage, at 60*s*. 80*s*. or 100*s*. per ton freight.

That this principle is but fair and reasonable, and is recognised by the Legislature in the Leith Dock Acts.—At that expensive dock the dues are 8*d*. per ton, chargeable only eight times in any one year; and this is not complained of by large vessels making few voyages at high freights; while it operates as an exemption on all voyages over eight, which are and can only be made by small vessels on short voyages with consequently low freights.

> May it therefore please your Honourable Board to take this case into your immediate consideration, and to give such relief in this case as is enjoyed in other the most favoured localities; to abate the Bell Rock Light charge altogether; to modify the charge on steamers on this short day-light run to 20 or 30 charges per annum in full, or to abate the tonnage charged on to a fifth or sixth of the full register tonnage, to such a tonnage as shall be equal to the actual weight or measure of freight usually carried, or give such other relief as shall to your Honourable Board seem fair and reasonable.

And your Petititioners shall ever pray,

THOMAS BARCLAY, 44 *Barnard-street, Leith.*
For the Edinburgh and Dundee Steam Packet Company.

No. 20.

No. 20.
Mitchell, on the management of the Harbour.

MR. JOHN MITCHELL'S *Remarks on the Management of Leith Harbour.*

Leith, January 14, 1847.

As my general opinion regarding the Port of Leith, I refer to my examination in the minutes of evidence accompanying the "Report of the Select Committee of the House of Commons," printed 6th July, 1835. I am still of opinion that we cannot obtain such a harbour as the metropolitan port of Scotland is entitled to, unless the deep-water entrance is made beyond, and out of the influence of, the deposits of the present entrance which are formed by the rivulet of Leith.

Leith is unquestionably the place where a harbour of refuge ought to be erected, and the expense ought not to be made a bar to the undertaking when the necessity of such a harbour is considered.

The numerous plans by Rennie, Grainger, Stevenson, Cubitt, Walker, Wallace, Fiugman, Anderson, Dall, Crichton, and others, have been before the public, and it is quite clear that the new entrance and harbour ought to be to the west of the present entrance, because there the *greatest depth of water can be obtained at the shortest distance from the shore.*

But it would be great presumption in me, or any one not acquainted with the difficult scientific question of harbour building, to point out which is the best plan, or if any one of them is sufficient.

It is the opinion of nautical men generally that the retention of the eastern pier will be of no benefit whatever in regard to the facilitating of steam navigation or the admission of larger ships, and that the farther out it is carried, the farther out a bar will be formed; while the idea of passengers landing on a pier nearly a mile from the shore, subject to the effect of storms and the waves of the sea, is in itself preposterous. It has been suggested that the eastern sands should be taken in and another town and harbour formed there; if the proprietors and inhabitants of Leith wished to see their property and their business destroyed, no better plan could be followed; it would have unquestionably the effect of turning South Leith into a Giles Street or Coal Hill, and ultimately the object could not be so readily obtained as by a harbour formed to the westward.

The attention of the Tidal Commissioners was directed to the fact of the want of accommodation for the present trade of the port, which was greatly occasioned by the Government having, without the consent of the inhabitants, taken possession, by authority of an Act of Parliament, of the western part of the West Dock; the Government ought to give this up, or, at all events, such parts of it as are not required for the few gentlemen's yachts that winter there.

I consider it admits of a question how far the inhabitants of the metropolis of Scotland and the port ought to be sacrificed in this manner; the Government may take the whole revenues if entitled to them, but can any Government legally or justifiably cut off the inhabitants from part of their coast, part of their harbour, part of their shore?

I shall not enter largely into the question of debt or revenue as connected with the assumption of this part of the docks by the Government, further than to affirm that it can be clearly proved (as I think I have proved in a pamphlet published some time since) that, if the Government or legislature had properly protected the inhabitants, the whole of the debt on the docks and harbour would have been long since paid off. It is well known that the former self-elected magistrates of the city misapplied the revenue to municipal purposes, and not to its legitimate purpose, and the inhabitants have since been subjected to the most grievous system of harbour charges ever exacted, to make up for that dilapidation, which they, the inhabitants, had no power to prevent.

I say most decidedly, and after fully considering the subject, that to deal justly by the inhabitants the Government ought to give up the existing claim for the debt, and that part of the west dock above referred to.

In the pamphlet referred to I prove that the shore-dues' yearly free revenue, exceeding the 3-4ths of the average of the five years preceding the year 1788, yielded 9000*l*., but say 8000*l*. from 1806 to 1835:

Twenty-nine years at 8000*l*.	£232,000
The dock-dues, from 1806 to 1835 (not including pontage, feu-duties, nor rents), average about 8000*l*., but say 7000*l*.: 29 years at 7000*l*. per ann.	203,000
	435,000
Deduct expense of building the docks, as per city statement	193,274
Overpaid or due by the city	£241,726

APPENDIX C.

LEITH.

No. 20.

Mitchell, on the management of the Harbour.

So that the expense of building the docks has been long since repaid by the port; and the debt due to the Government ought only to be claimed by the Government from the city.

Port Charges.—As to the particulars of the charges at this port, I beg to refer to the minutes of my evidence before referred to, where for the first time was given an accurate statement of the charges, and where also for the first time is given a table of rates and charges of shore-dues *in sterling.*

The charges *on shipping* are exorbitant and unjust, particularly as compared with the *charges on goods.*

The average charge for harbour-dues on ships (exclusive of pilotage and ballast, is about 1*s.* 3*d.* per ton (the rate of 4*d.* per ton on coasting vessels included).

The charge for the harbour-dues at	Glasgow is	2*d.*	per ton.
	Dundee	3½*d.*	„
	Aberdeen	1½*d.*	„

The shore-dues on goods again are moderate compared with the same charges at other ports: goods pay only once, whereas ships are subjected to a continued tax, which is felt to be much against the shipping interest and commerce in general.

The shore-dues can easily be modified or regulated in such a way as still to keep up the amount of revenue collected at this port, and so as to afford such a reduction on the charges on shipping as may be considered reasonable, say one-third or one-half of the charges on ships.

By the 12th section of the present Docks Act, it is enacted "that it shall be lawful for the Commissioners to abolish, reduce, equalize, and consolidate the rates and duties leviable at the said harbour and docks, so as to render the same more equitable and just."

The Commissioners have never exercised this power, but ought to do so without delay.

Ballast.—The charge for ballast is unreasonably high and ought to be reduced; the charge is—

Per ton for ballast shipped	1*s.* 3*d.*
Ditto landed	0 9

By the Commissioners' "Abstract of Revenue and Expenditure," it appears that there is a profit on this department of from above a third to a fourth, and therefore the rates ought to be reduced at least one-fourth; this reduction may be considered trifling, but would be hailed as a great boon by the shipping interests, and it is certainly unjust to exact a profit in this department while the ships are prevented from getting ballast in any other way.

Expenditure.—The expenditure is enormous beyond all reason.

Salaries.—If the charges were consolidated a considerable saving may be effected in the collection.

The salaries and tonnage at different ports prove this, as may be seen from the following statement in my report in 1835, and the proportions are similar still:—

	Tonnage.	Salaries.
Leith	22,073	£2,402
Greenock	55,780	290
Dundee	36,321	795

In the Abstract ending May, 1843, it appears that the various sums paid for salaries and wages and personal services (exclusive of law accounts and contracts) amount to 4091*l.* 6*s.* 11*d.*

	£.	*s.*	*d.*
One of the items stands thus: "Wages to joiners, carpenters, blacksmiths, masons, labourers, and others, for repairs and other operations connected with the harbour and docks"	1,789	17	6
In the year ending 15th May, 1844, the salaries, wages, and personal services, amount to	4,899	7	1
Of which the wages to joiners amount to	1,369	1	6
In the year ending 18th May. 1845	5,508	11	4
And the wages to "joiners," &c.	2,130	16	9
In the year ending 15th May, 1846	5,165	16	6½
"Wages to joiners," &c.	1,857	11	0½

The wages are exclusive of the ordinary harbour servants; and as the repairs and other operations of any extent (as appears by the abstract) are paid for separately, what is the use of this host of "joiners, carpenters, blacksmiths," &c.? I should certainly say that it would be much cheaper to let all repairs be done by the respectable master joiners, carpenters, blacksmiths, &c., of Leith, than to pay salaries or wages to men who cannot always be required or employed.

I consider that it is evident that there may be an annual saving on the head of wages, salaries, and personal services, of 2500*l.*

Along with this saving I may point out the additional revenue that may be obtained by fencing out the valuable piece of ground occupied as the Commissioners' depôt or warehouse at the south-east end of the west dock: ground sufficient for the purpose may be obtained at the opposite side, or north-east end of the same dock.

The continued annual expenditure, on what is called the Cross Weir, ought to be put an end to as worse than useless.

Altogether I have no hesitation in offering to effect an annual saving of 3000*l.* in the expenditure without in any way impairing the efficacy of the establishment.

The Tidal Commissioners' attention is particularly called to the fact, that, owing to the falling away of the ground, the road between the only low-water pier that Leith possesses, at Newhaven, has become impassable: the construction of this road is imperatively required; the Cramond Road Trustees are bound by statute to make the road; and, at a meeting of the General Board of Trustees (which I was appointed to attend as convener of a Committee on the subject), Viscount Melville stated that the said Trustees are bound to make the road, but the excuse was the want of funds; it is of importance to consider that valuable Government property will be improved by the renewal of this important communication: the Admiralty's property at the West Dock, the Ordnance property at Leith Fort, the Admiralty property at Annfield, Newhaven, are all of great value, and which value would be greatly enhanced if this road were made. It is respectfully submitted that Her Majesty's Government should unite with the Harbour Commissioners and the Road Trustees to carry the measure into immediate execution as an improvement of urgent necessity

No. 20.
Mitchell, on the management of the Harbour.

To make the road passable, a printed letter, in my possession, of the Cramond Trustees, dated 31st July 1841, proves that the road might have been reconstructed for 2000*l.*: another but more expensive proposal shows that the cost would be 3718*l.* 5*s.* 4*d.* I am satisfied that the road might be sufficiently made for a less sum, but the onus ought to be placed on some party or other, and the Government and Harbour Commissioners ought to step in immediately to enforce the statute, or to assist with the necessary funds, if requisite. The 2000*l.* applies to the healing of the breach made by the sea; the additional sums apply to the making of a bulwark, widening and improving the frontage of Leith Fort and Hamburg Place; the expenditure of 2000*l.* would effect a passage by the sea-shore—the great desideratum; the laying out the additional sum would be of secondary necessity, although useful.

Independent of the importance of the renewal of this road in a national point of view, it may be stated that the pilots who reside at Newhaven have to go a considerable way round about to get to and from their avocations, and that much of the usual trade of Leith has been injured by the merchants and traders from Fife going to Edinburgh instead of Leith to effect purchases; so that it really is of great importance to all parties.

Lights.—The only additional remarks which I consider it necessary to make are regarding the lighthouse-dues exacted by the London Trinity House and the Northern Light Commission, as to which I refer generally to my evidence before the Select Committee of the House of Commons on Lighthouses last year, as embodied in the minutes.

They are unquestionably objectionable as pressing severely on the shipowners and the commercial inhabitants of this great maritime nation:—

1st. They are much higher than they require to be.

2nd. Part of the funds are misapplied.

3rd. They prevent trade and seriously impede commerce; for the full light-dues are exacted if only a small quantity of goods are shipped, so that a vast quantity of goods are actually prohibited from being exported by the Trinity House of London and the Northern Light Commissioners, to the great injury of the merchants of this country: vessels are charged with light-dues which do not use or require the lights, and the tax is most unjust in many cases, such as the case of steamers passing during daylight.

At the meeting with the Tidal Harbour Commissioners, in examining one of the witnesses as to the light-dues, it was stated that only some partial reduction was lately made on the general charges for lights; but other questions foreign to this subject having been thereafter asked, I was prevented stating that, solely owing to the interference of our member, the Lord Advocate of Scotland, a very great saving to the shipping interests of this country had been effected by obtaining the exemption of the charge for the Bell Rock lighthouse on vessels sailing to and from the south, and which ought to be generally known as one of the many benefits that he has conferred.

4th. The public generally is benefited by the lighthouses, not only as passengers, but in so far that Her Majesty's ships of war pay no light-dues.

I would therefore recommend that the actual expense of maintaining the lights be defrayed out of the national revenues, and that the management be continued under three efficient boards resident at London, Edinburgh, and Dublin. I consider the attempt at centralizing all such management at London as altogether unwise, unjust, and pernicious. There is unquestionably an advantage in, but a fair limit to, centralization; place the controlling power at a great distance, and mismanagement must be the consequence: independent of this, it is most injurious to the servants of such establishments, who, absent from the head department, do not find their services appreciated or rewarded, and the best appointments are lodged in the central boards, so that only the servants near, or the friends of such boards, are promoted.

I speak from experience: when we had the Board of Customs at Edinburgh, the merchants in Scotland had their petitions answered, and their reasonable wishes attended to, without delay; now, it takes weeks before answers can be obtained, and commerce is often much impeded in consequence. The evils of centralization, the utter ignorance of the officers, and the unfitness of the system are powerfully exemplified in the many frauds discovered lately in the Customs department at London. The Scottish officers of Customs are neglected: men of much superior ability and education to those of equal rank in the sister kingdom see their inferiors placed over their heads; and almost all the best offices in the Customs in Scotland are now occupied by Englishmen: therefore, let no true friend of Scotland talk of any centralization beyond Edinburgh, if they do not wish Scotland turned more into a mere province than it actually is.

These last remarks I intend to apply to a Bill proposed to be introduced for the government of harbours. I consider the proposal may be useful if such a law is made to apply to the establishment of separate Boards at London, Edinburgh, and Dublin; but if the withering principle of centralization is to be carried to, and established at, the already overgrown metropolis, why then I consider that we shall be subjected to much annoyance from men ignorant of our local wants, means, and interests.

JOHN MITCHELL.

No. 21.

Report by JAMES M. RENDEL, Esq., *C. E., F. R. S., on the improvement of Leith Harbour and Docks.*

No. 21.
Rendel, on improving the Harbour and Docks.

Great George Street, Westminster, January 19, 1847.

SIR,

As directed by the Lords Commissioners of Her Majesty's Treasury, in your letter of the 5th August last, ($4317\frac{8}{7}$), I inspected Leith Harbour and Docks in the following month. During a portion of the time I was employed on the survey, I had the advantage of the company of Mr. Leslie, Mr. Dall, and other local official gentlemen, whose long and professional acquaintance with the harbour and its approaches greatly facilitated the necessary inquiries.

I had also a long conference with a number of the Trustees, which resulted in a special meeting of that body, and the transmission to me of a paper, setting forth their unanimous opinions in the form of resolutions.

My instructions were, to report especially on the plan proposed by Mr. Leslie for the extension of the Eastern Pier, and that, should my opinions not agree with those of Messrs. Walker and Jardine, which are in opposition to it, and in favour of a different plan, that I should state in what respect I differ from these gentlemen.

APPENDIX C.

LEITH.

No. 21.
Rendal, on improving the Harbour and Docks

I beg to premise, that owing to the natural difficulties which surround the question at issue, and the consequent diversity of opinion that exists as to the best plan of effecting the requisite improvements, I found it absolutely necessary, not only to make a minute inspection of the harbour and the adjoining shores, but to read carefully the history of the port, as given in the numberless Reports that have been made by engineers and others; and to request that new soundings might be taken, and surveys repeated, that I might compare the present state of the harbour with its similarly recorded condition in 1828 and in 1831.

These new surveys necessarily occupied considerable time, and it was not therefore till November that I received them. Since then, I have given great attention to all the facts and opinions collected, and I have now the honour to submit the conclusions to which I have arrived on the whole question of improving this harbour.

I agree in opinion with Messrs. Walker and Jardine, that the extension of the East Pier, and the formation of a low-water landing for large steamers at its head, in the manner proposed by Mr. Leslie, is not calculated to benefit the port to an extent that will justify its cost.

I also think, that, whilst it would offer but a very partial and uncertain degree of accommodation to vessels requiring its use, its great distance from the town of Leith, the exposure of the way to it in bad weather, and the difficulty and expense of connecting it with the railway now uniting Leith with Edinburgh, &c., would further depreciate its value to the public, and interfere with its success.

In the arrangement of the design, Mr. Leslie has skilfully devised the best means which the principle of the plan admits of for sheltering vessels whilst using it as a landing-place; but I am of opinion that, owing to its great distance from the land, and the long sea-reaches to which it would be exposed from west all round by north to east, it would prove to be little better than a fine-weather pier; whilst it would be unattended with any adjunct advantages to the harbour or its entrance channel.

In coming to this opinion, I have not lost sight of the fact, that such a landing-place as Mr. Leslie's plan proposes would only be used at such times as a steamer or other vessel could not pass up the channel, or into the harbour, or say from one-fourth ebb to three-fourths flood tide, and that the sea is at such times less violent than at high water; still I am of opinion that, even with slight gales, there would be too much sea upon it for convenient landing when the water was sufficiently deep, and that, from three-fourths ebb to one-fourth flood, vessels would be in danger of striking on the bottom, seeing that the depth at low water (spring tides) is under eight feet.

I have remarked, that this work would not benefit the harbour channel. This should be explained. The plan is to unite the solid low-water landing-place with the present pier, by a roadway supported on piles, through which the current of tide will pass, and prevent, as far as possible, the tendency which a solid erection has to cause an accumulation of sand, and the consequent detriment to the landing-pier. It is also cheaper than a solid pier. But these qualities, which are favourable so far as the landing-pier is concerned, make the works useless to the general commerce of the harbour, since it offers neither shelter to shipping nor increased facilities for deepening the harbour channel.

Now, as I quite concur in the opinions stated by the Harbour Commissioners, in the resolutions attached hereto, viz.—that the improvements required in the port of Leith are a low-water pier and landing-place, made in connection with the deepening of the harbour channel, and combined with an additional dock for steamers and the large class of sailing ships—I am, as before stated, adverse to Mr. Leslie's plan; because, whilst it very partially meets the first requirement, it in no degree facilitates the accomplishment of the two latter, which are of equal public importance, and even more necessary, to secure the public debt on the harbour.

As Mr. Jardine has not furnished a plan, but merely confined himself to an opinion on Mr. Leslie's I have only further to state in what my views differ from the plan of Mr. Walker; and to make myself clearly understood, I have found it necessary to prepare a design, which I attach.

I agree with Mr. Walker in opinion, that it is inexpedient to abandon the present harbour and the further improvement of its entrance channel in favour of a more westwardly entrance. I do not, however, concur with him in thinking, that it is necessary or practicable to make and maintain a channel twelve feet deep at low water up to the docks and town. Of course, I mean that it is not practicable, having reference to expense. To make such channel, it would be necessary to incur a very considerable outlay on the present pier, to prevent its being undermined; the new works must be of an expensive kind, whilst the yearly cost of dredging, to maintain such a depth, could not fail to be excessive.

The utmost depth which I have any hope of seeing made and permanently secured at a reasonable expense is six feet below low water or the present dock sill, or half that proposed by Mr. Walker. The channel, when enclosed by parallel piers, and deepened to that extent by dredging, may, I think, be kept in good condition, by the occasional use of a dredger, and proper attention to harrowing during land-floods. I agree with Mr. Walker, that there are no just grounds for the opinion which some entertain, that the water of Leith brings down from the country, and deposits in the harbour, more sand and sediment than it removes; consequently, that a new channel made independent of this river would be more easily maintained than the present channel. On the contrary, I have no doubt upon my mind that the river, even at present, takes to sea much more sand and silt than it brings down from the land, and that, with a strict conservancy over its banks, its advantages would be still greater. But to derive the full benefit of the scouring power of the river, the harbour channel must not only be confined within walls, but must be of much more limited depth and width than in Mr. Walker's plan; and in naming six feet as the greatest practicable depth, I have gone to the utmost limit which I think it safe to calculate on.

It will be inferred, from what I have said of the necessity of confining the channel between piers, that, like Mr. Walker's, my plan is to carry out a west as well as an east pier into deep water. But as I do not agree in the propriety of attempting to maintain a channel twelve feet deep, I propose to make a low-water landing at the head of the west pier, under shelter of the east pier.

Mr. Walker's plan also proposes an additional dock, suitable for steamers and larger ships than can be accommodated in the present docks; and though I agree with him, as before remarked, I do not concur in the selection of the site for such dock, finding, from borings I have had made, that its cost, particularly for the northern end and entrance lock, would be attended with a great expense, owing to the depth of the quicksand in that part of the harbour. I have selected a more favourable site, where the clay is only a few feet below the surface.

On these several accounts, the cost of Mr. Walker's works would be nearly the same without the new dock as mine would be with it. In addition to these contrasts, the plan which I shall now proceed

APPENDIX C.

LEITH.

No. 21.
Rendel, on improving the Harbour and Docks.

to describe would have the further advantage of being easily connected with the dock, or Commercial Street station of the Edinburgh and Leith railway, and of providing for its extension to the low-water pier.

It will be seen on the accompanying plan that I propose to extend the east pier 1000 feet, the first half being in the line of the present pier, and the remainder curving to the west, so as to shelter the harbour channel from all points, north of Kinghorn Ness, and consequently covering it from the open sea exposure—Kinghorn Ness being north (true) from the pier-head, distant about five miles. It will also be seen on the plan, that I propose to extend the west breakwater upwards of 1750 feet in a north-by-west direction, or slightly opening the east pier-head, and terminating it with a low-water landing-pier, 350 feet long, canted one point westerly, making the harbour entrance 200 feet wide in the clear, and giving it a north-west aspect which is as sheltered as any that can be obtained consistent with easy entrance for deeply-laden vessels, when the wind is from the bad-weather points on this shore.

It should be further observed that, though the entrance is but 200 feet wide, the curved form of the east pier gives a breadth of upwards of 400 feet, immediately within the pier-heads, so that vessels would find room to turn, or to beach themselves in quiet water, if waiting for the tide to pass up the harbour channel. This form is also advantageous to long vessels, such as steamers, using the low-water landing-place, by giving them room to turn in approaching or leaving the pier.

I propose only one slip to be formed in this landing-pier. This slip will be covered on the eastward by the east pier, whilst, from its being on the harbour side of the west pier, it is equally protected from those winds. One slip, therefore, by this plan, would afford as much accommodation as the two proposed in Mr. Leslie's plan, and be more sheltered, as the eastern pier is a complete protection for it in north-east gales, which make the worst weather on this shore. The same argument applies, in contrasting the advantage of approaching the landing-place, for, as the eastern is the weather pier, and completely exposed for its whole length, or 1400 yards, the traffic between the town and the landing-place would be frequently impeded, and on some occasions stopped. To this objection, the further one of expense must be added. The present east pier is too narrow for either a single line of railway or a carriage-road, being merely a broad footway, and to increase its width would be attended with a considerable expense.

Again, a low-water landing-place at such a great distance from the town and traffic of the port could not be made remuneratively useful, unless it had direct communication with the shore and docks by railway. This would be next to impracticable, if such landing-place were made at the end of the east pier, but, by making it at the head of a new west pier, a direct railway communication may be opened between it and the station of the Edinburgh and Leith railway in Dock Street, offering, at the same time, the greatest possible facilities for branch railways to every part of the present and proposed docks.

Looking to the modern necessity for despatch and economy in every department of business, and more especially such as is connected with ferry traffic and steam navigation, the trade of Leith cannot otherwise than suffer, if left under the disadvantage of inferiority to Granton, &c., in this respect. By the plan proposed, this disadvantage will be removed, for the depth of water at the pier-head will be upwards of eight feet at the lowest ebbs, and, being completely sheltered from the easterly and westerly winds, this depth at low water is equivalent to a depth of twelve feet at a landing-place open to gales from those points.

The cost of constructing the west breakwater now proposed would be justified by the attainment of these important objects only: but I consider such a work necessary for the maintenance of even a six-feet channel, at low water, up to the docks. The sands, to the west of the harbour, though not so extensive or elevated as those on the east, are of considerable area, taking those portions which have up to six feet of water over them at low-water spring tides. I am therefore of opinion, that no channel can be made permanent through these flat sands that has not the protection of a pier to prevent the tendency which breaking waves have to fill up all inequalities, such as channels formed in a flat sand. I am aware that the travel of the sand on this coast may be said to be generally from the east, and that the easterly winds and flood-tide currents occasion a much more rapid accumulation at the back of the east pier than is found at the back of the west breakwater. I find, from a comparison of the soundings taken in 1828, 1831, and 1846, that there is an increase also on the west side of the harbour, whilst a section I have caused to be taken through the middle of the harbour channel shows its depth to be nearly two feet more down to the head of the west breakwater than it is outside it; the difference in depth taking place, in the most striking manner, at the head of the breakwater, where the channel ceases to be confined and sheltered; and beyond that point the channel is lost, the sandy bottom along the east pier agreeing in general levels and character with the adjoining portion of the bay; thus proving, that it would be in vain to dredge a channel through these sands, without at the same time enclosing it, so as to confine the currents to one track, and prevent the effect of breakers passing over it at right angles to its course.

Between the south end of the west breakwater and the north wall of the intended dock, the railway would be carried on a wooden platform, supported by piles, leaving openings of sufficient width for boats or rafts of timber, so as to constitute the western half of the outer harbour or basin for boats, and giving facilities for the formation of timber-ponds.

The proposed dock is placed on ground most favourable for economical construction—is completely contiguous to the present east dock—has its entrance upon the present channel, so as to combine the expense of an improved channel into the present harbour with the new dock entrance—is on the line of railway—is accessible in the most direct manner possible with Dock or Commercial Street, and leaves on its north side a suitable site for two large graving-docks.

I have before stated, that I propose to form a channel up to this new dock entrance, six feet deep, by dredging; that I consider this the greatest depth that can be maintained with any certainty at a moderate expense; and that for this purpose the water of Leith may be made to a great extent available. I propose the sill for the new dock entrance to be laid at the same level, viz. six feet below the sill of the present lock. I have ascertained that the mean rise of the tides of the year is about sixteen feet on the old dock sill, that the mean of neaps is about thirteen feet eight inches, and the lowest neaps about thirteen feet. On the new sill, this would give at high water a depth, on the average of all tides, of twenty-two feet; at the average of neap-tides, nineteen feet eight inches; and at the lowest neaps, a depth of nineteen feet. We may therefore consider that, for two hours (an hour before and an hour after high water) each tide, vessels drawing sixteen feet six inches would be able to pass in and out of this dock on the lowest neaps, and so in proportion for all tides rising above the lowest neaps. Now,

APPENDIX C.

LEITH.

No. 21.
Rendal, on improving the Harbour and Docks.

as it must be admitted an additional dock is chiefly required for the steamers frequenting the harbour, and that none of these are likely to draw more than fifteen feet, I consider a dock with a single pair of gates as advantageous as though it had a lock, and I have prepared the design accordingly. The saving of expense is of course very considerable, whilst the only disadvantage is, that the level of the water in the dock changes with the tides of each day—a disadvantage of little importance in this instance, as the greatest difference between the extremes of springs and neaps is not more than six feet, whilst the difference between their means is not four feet. But in order to keep the largest class of timber and eastern produce ships afloat at all tides, I propose to excavate the dock to eight feet below the present lock sill; consequently, at the lowest neaps, there will be fully twenty-one feet of water in the dock, whilst the number of tides would be but very few in the year when such vessels, say, drawing nineteen feet, would not be able to pass from sea into the dock, during an hour or hour and a half each tide.

The gates are proposed sixty feet wide, which gives ample room for the largest steamers used between any of the ports of Scotland and London.

I have not marked upon the plan any water connexion between the new and old docks, thinking it to be unnecessary for the present. I would, however, allude to the ease with which such a communication could be made, without in the least interfering with any of the railway or other important arrangements.

The proposed dock would be 700 feet long and 300 feet wide, being an area of $4\frac{8}{10}$ acres, with 1900 feet lineal of wharfage, averaging 100 feet in width.

It will be seen by the plan, that I propose to make a public way for the railway and carriages over the cross wharfs, which separate the two present docks. These wharfs are of little value as berths for shipping to discharge at, and may, therefore, be given up to the public, without loss of revenue or income to the docks. Of course, the docks would be fenced off, and the present drawbridge maintained; made wider, however, to take a line of railway, as well as the ordinary traffic.

In considering the details for the several works, I have assumed that all possible economy should be observed, consistent with their strength and efficiency. For the extension of the east pier, I have adopted the same plan of construction as in the present pier, strengthened in proportion to the greater depth. For the extension of the west breakwater, I have assumed a timber platform, twenty feet wide, raised seven feet above high-water spring tides, supported on piles, and protected from the weather and worm by a breakwater, formed on the principle proposed in Mr. Cubitt's plan for a western harbour, viz.—Two low-water mounds of rubble stone, with a clay nucleus, having stone-paved slopes, at suitable inclinations, raised above high water, and formed along the line of the timber roadway—the low-water landing having a slip, twenty feet wide, and a rise of one in fifteen, built of masonry, founded on piles at the level of low water, and enclosed with iron sheet piles driven into the strong clay, and having their heads well secured to the first courses of masonry. By this plan, the expense of founding walls in deep water will be saved, whilst, by means of the iron sheet piles to enclose the area, and a careful deposit of rubble-stone and clay round the wood piles, on which the walls would stand, the structure would be as durable as the circumstances could require. The dock walls I have assumed to be built of good sound masonry, and the entrance to be constructed in the most complete manner. The outside of the dock, against the harbour channel, to be also of masonry, but west of the gates to be a sloped embankment, paved with stone. This is desirable as a matter of economy, and on account of the probable demand, at no distant period, for the construction of graving-docks, which would make a wall an unnecessary expense.

The following estimate of cost is based on the mode of construction above described:—

Cost of eastern pier extension—western breakwater extension—low-water landing-place—roadway through the outer harbour—and deepening harbour channel, including ten per cent. contingencies	79,000	0	0
Cost of dock, comprising excavations, walls, entrance gates, and macadamised wharfs, including ten per cent. contingencies	56,000	0	0
Total	£135,000	0	0

Looking to the increase of trade consequent on the concentration of railways in Edinburgh, there is no doubt on my mind as to the propriety of expending the above sum for the attainment of the proposed objects. Neither can there be any doubt, that the repayment of the public debt on the harbour would be better secured by such an expenditure; for supposing Leith to remain without these several improvements, the necessities of the trade will open new channels, whereas the works proposed will give to Leith facilities which will not only insure the detention of its present trade, but also draw a fair proportion of the increase which the railways cannot fail to create.

In conclusion, I beg to recapitulate, in the briefest manner possible, the opinions expressed in the preceding pages.

That the construction of the proposed low-water landing-pier, at the end of an extension of the present east pier, is inexpedient, inasmuch as it would only very partially accommodate the class of shipping for which it is intended, is at a considerable distance from the town, and only approachable by a foot-road, greatly exposed; does not admit of being connected with the Edinburgh and Leith railway but at a considerable cost, and would not contribute to the improvement of the harbour channel, nor add to the shelter or convenience of vessels using it.

That the principle of continuing the improvements of the present harbour, and employing the land-floods of the water of Leith in aid of dredging for the maintenance of a channel up to the present docks and town wharfs, is preferable on every account to any plan that can be devised, at a justifiable expenditure, for making a new entrance to the west of the present harbour, and maintaining the same by dredging only.

That the three improvements mentioned in the resolutions of the harbour trustees appended hereto, viz.—a low-water pier, an improved harbour channel, and a new dock adapted for steamers and large ships—are each and all necessary to enable the merchants of Leith to retain and extend the trade of the port.

That it is not practicable to improve the present entrance channel without confining it between *two* piers, or, in other words, without lengthening the western breakwater to the same extent as the eastern pier.

That, by the extension of these piers as laid down upon the accompanying plan, a channel of six feet in depth below the present lock sill may be made and maintained at a reasonable cost.

No. 21.
Rendel, on improving the Harbour and Docks.

That the low-water landing-place should be made at the head of the proposed west breakwater, under the shelter of the eastern pier.

That the new dock should be in close proximity to the present docks and old harbour channel, and have the most direct approach from the town.

That it is essential to connect the low-water landing-place, and the present and proposed docks, in the most direct manner possible with the Edinburgh and Leith railway station in Dock or Commercial Street, and so construct the new works as to admit of a railway being laid along them.

That to carry out such railway connexions, &c., it is expedient to open a public road across the drawbridge, over the passage which unites the present docks, and to connect the proposed new dock with the new western breakwater by a roadway formed on arches—and,

That the execution of the several works for effecting these improvements would add to the security of the public debt.

It is due to the present authorities, and Mr. Dall, the harbour-master, that I should not omit to mention the great improvement which their attention to the harbour channel has effected since 1831. By sections I have had made, it appears that since that date the channel from the first bridge to the head of the western breakwater has increased in depth upwards of three feet, whilst the piers and other works have been kept in efficient repair. As might have been expected, the revenue of the harbour has increased with its improvement; but I forbear to enter on the question of finance, from its forming no part of my instructions.

Whatever may be the decision as to further expenditure on this harbour, it is highly desirable that the conservancy powers of the Commissioners should be increased, not only over the harbour, to the extent of the tidal flow, but also for the whole course of the river.

C. E. Trevelyan, Esq., &c. &c.,
Treasury.

I have, &c.,
JAS. M. RENDEL.

I beg to return, herewith, all the plans and papers forwarded to me with your instructions.

No. 22.

No. 22.
On the want of a Time Ball.

Instructions Relative to the want of a Time Ball at Leith, from the Hydrographer to the Admiralty.

SIR,

Admiralty, September 1, 1846.

AN application having been made to the Admiralty to procure the erection of a time ball on the Observatory at Calton Hill, for the benefit of the vessels lying in Leith Docks, and as there will be no objection on the part of the Board to this request provided the ball may be seen directly from those vessels, or from a majority of them, their Lordships desire that if you are about to proceed to Scotland, as you notified to me yesterday, you will pass through Edinburgh, and report to me fully on the above matter for their Lordships' information.

You will likewise explain to Mr. Piazzi Smyth, the astronomer there, the method by which the Greenwich ball drops, so as to make little or no concussion; and consult him on the height to which the staff or tube could be elongated, if any reasonable increase might render the ball visible in the Docks.

As Captain Vetch, R.E., will be with you, and as he is no doubt acquainted with the process of laying down the electro-telegraphic wires, ask him to make a rough estimate of the expense of such a communication, between the Observatory and a ball or clock, which might, I suppose, be placed in some conspicuous situation at the Docks.

I am, &c.,
F. BEAUFORT, *Hydrographer.*

Captain Washington, R.N.

No. 23.

No. 23.
Washington and Vetch, on the want of a Time Ball at Leith.

Report on the want of a Time Ball at Leith, by CAPTAIN WASHINGTON, *R.N., F.R.S., and* CAPTAIN VETCH, *R.E., F.R.S., addressed to the Hydrographer of the Admiralty.*

SIR,

London, December 26, 1846.

ADVERTING to your letter of the 1st September, stating that, "An application having been made to the Admiralty to procure the erection of a time ball on the Observatory at Calton Hill, Edinburgh, for the benefit of vessels lying in Leith Docks, and that there will be no objection on the part of the Admiralty to this request, provided the ball may be seen distinctly from those vessels, or from a majority of them;" and in compliance with your instructions, directing us to examine and report to you fully on this question, for their Lordships' information, we have the honour to state:—

That on our arrival in Edinburgh we put ourselves in communication with Mr. Piazzi Smyth, the astronomer; Mr. Dall, R.N., superintendent of Leith Harbour; Captain Arrow, R.N., inspecting commander of the coast guard, and Messrs. Bryson and Sons, Dickman and Laird, the principal chronometer makers in Edinburgh and Leith.

From the last-named gentlemen we ascertained that the number of chronometers sent to them to be rated by ships sailing from the Firth of Forth, was last year not less than 120, and in 1846, it was expected they would reach 150; this number is exclusive of those which are rated at Alloa, higher up the Firth; of those carried by vessels that occasionally anchor in Leith Road, whether calling for orders or driven in by stress of weather, of French vessels-of-war protecting their fishermen (two of which were there at the time of our visit), and of all Her Majesty's ships.

It thus appears, independently of other advantages, that the exhibition of a time ball at Edinburgh would be of immediate practical utility to a very much larger number of vessels than any former accounts had led us to anticipate, and we are the more desirous to state this clearly at the outset of our inquiry, as we are disposed to believe that had the Admiralty been made acquainted with it sooner, their Lordships would not have limited their concession of a time ball by the condition of "its being visible from vessels in Leith Docks."

APPENDIX C.

LEITH.

No. 23.
Washington and Vetch, on the want of a Time Ball at Leith.

Not only is the Observatory, though situated on the Calton Hill, not visible from the Docks, but Nelson's Monument, the loftiest building there, is invisible from the deck of any ship in the Docks, owing to the height of the adjoining warehouses which intervene. Nelson's Column, however, is distinctly seen from the "tops" of the greater part, if not from all of the vessels so placed, as well as from the whole of the north shore in the immediate vicinity of the Docks, and from Leith Peir. It is also prominently conspicuous from every part of Leith Road and the Firth of Forth, from near St. Margaret's Hope on the west, to Aberlady Bay on the east. But even if the Observatory were visible from the decks of vessels in the Docks, it would be of little service to them, as it is the common practice to send the chronometers on shore to the maker immediately on a ship's arrival, and not to receive them on board again till the day before sailing; nor would it seem desirable to interfere with this practice, as the concussion caused by unloading and loading a ship could not fail of being prejudicial to the steady going of the watches.

On consulting with the astronomer, we found that with every disposition to forward the cause by all means in his power, he felt it his duty to object to any erection in contact with the Observatory, as from its elevated position and exposure to frequent high winds, there would be a risk of disturbing his instruments. He must also object to any additional erection placed so near as by subtending a large angle as seen from the Observatory, it might impede extra meridian observations, there being already too many obstructions of this nature, as Nelson's Pillar, and the columns of the National Monument.

These reasons appeared to us so conclusive, that we at once gave up all thought of the Observatory, and turned our attention to one of the existing buildings, and we found that Nelson's Monument combines more than any other the requisites we could desire.

This monument, as is well known, consists in a stone tower 100 feet high, and substantially built, surmounted by a smaller tower and flagstaff, the summit being at an elevation of about 500 feet above the sea; in this upper tower the slight machinery necessary for heaving up the time ball might be placed, and thus not interfere with access to the large tower by the public, who frequent it for the sake of the fine view it affords.

As the monument is the property of the City of Edinburgh, we sought an interview with the Lord Provost, who immediately gave his own sanction to the proposal, and said he was sure it would receive the same from the Town Council. His lordship added, "that he could not imagine a more appropriate use for a monument in honour of Nelson than that it should be rendered serviceable in communicating correct time to sailors and to the public."

It remains to consider the means of connecting the column with the Observatory, as carrying a chronometer every day from the transit clock to the top of the tower seemed to be unnecessary trouble, and for this purpose two plans readily suggested themselves.

One by a system of rods and cranks laid in tubes underground to the foot of the Column, and thence up the shaft, for which plan Messrs. Bryson and Son readily undertook to prepare a drawing and estimate, whence it appears that the expense of connecting the time ball with the Observatory by this method would not exceed 100*l*.

An objection might be urged against the use of rods and cranks from the effect of expansion and contraction in heat or cold, but Messrs. Bryson are of opinion that this difficulty may be obviated by a tension weight at the end of the lever, which would keep the chains tight in heat, and in cold would relax only the proper amount.

As the observer would not be able to see the ball from any part of the interior of the Observatory, Messrs. Bryson propose placing an oblique mirror outside, reflecting an image of the ball, so that the observer, while counting the seconds by the transit clock, with the wire in his hand and his eye on the mirror, might discharge the ball with perfect accuracy.

The other plan was to establish direct communication by means of an electric wire. On this point we applied to Mr. Bain, who laid down the Edinburgh and Glasgow electro-telegraphic wires; this gentleman readily acceded to our request, and having examined the locality, and fully considered the subject, he is of opinion that a wire may be easily led from the transit room of the Observatory to the summit of Nelson's Monument; that the electric force will be amply sufficient to discharge a detent or trigger, which will detach the ball, and that, if thought requisite, the end of the wire may be connected with the transit clock, thus doing away with the possibility of error on the part of the observer.

Mr. Bain's estimate does not exceed 52*l*.

Since our return from Edinburgh we have examined the time ball at the Royal Observatory at Greenwich, and have had the advantage of an explanation of its machinery by the astronomer royal, and Mr. Main, the chief assistant. This ball is 5 feet in diameter, and falls 10 feet, and seems to have answered its purpose remarkably well, and to have been dropped with great accuracy, its mean errors not exceeding three-tenths of a second, or less error than that likely to be made by the observer who is on the look out for its fall. Owing to the ball at Greenwich being attached to the Observatory, it was necessary to prevent the concussion caused by its fall as much as possible, which has been accomplished by means of the compression of the air obtained by a piston working in a cylinder. This precaution will be less necessary at Edinburgh, nor does it seem requisite that the ball should fall through a space greater than its own diameter, which should not be less than 6 feet.

With respect to the machinery for hoisting up and dropping the ball, there will be little difficulty. Mr. Dall, the harbour superintendent at Leith, who for six years has been zealously urging the adoption of this measure, has a model of that at Greenwich.

Professor Chevallier, of Durham, also has made a model of a simple piece of machinery for this purpose, the cost of which would hardly exceed 100*l*.

In addition to the immediate benefit to sailors, the exhibition of correct Greenwich time at Calton Hill will be of great service to the public in general, the more so since railway travelling requires so much greater precision than formerly; and in the event of Greenwich time being adopted throughout the country, which seems a most desirable measure, now that railroads are so extensively spread, the value of such an establishment will be much enhanced.

Another advantage will be the stimulus given to masters of merchantmen, when lying in Leith Road, to pay attention to their chronometers, the recent regulations respecting masters and mates passing an examination almost calls for some such help being provided for them, and it is gratifying to know from the nautical instructor at Leith that the number of this class who attend his school is greatly on the increase. Of the necessity of such assistance, as far as Government vessels are concerned, we can bear the fullest personal testimony, as on the occasion of Her Majesty's visit to Scotland, in 1843, as many as

APPENDIX C.

LEITH.

No. 23.
Washington and Veitch, on the want of a Time Ball at Leith.

eight vessels of-war were lying in Leith Road, and, owing to bad weather, were unable to land, and get sights for time; and from want of such a signal, after lying there for some days, the *Pique* frigate sailed for America without any opportunity of rating her chronometers. Foreign vessels of war, both French and German, have recently been put to the same inconvenience while at Elsinore.

In the comparatively small state of Denmark, it appears that a time ball has been exhibited since the year 1843, at the special instance of the Danish hydrographer, Captain Zahrtmann.

It only remains to add, that during our inquiries at Edinburgh we met with every assistance; not only sailors but all parties, including the distinguished astronomer, General Sir Thomas Brisbane, were unanimous as to the benefit such an establishment would confer, and earnest in their hope that their Lordships would see fit to recommend this measure to the favourable consideration of her Majesty's Government.

We are, &c.,

To Rear Admiral Beaufort, F.RS.,
Corr. Inst. France, Hydrographer.

JOHN WASHINGTON, *Captain, R.N.*
JAMES VETCH, *Captain, R.E.*

No. 24.

Return of Income and Expenditure of Leith Harbour.

No. 24.
Return of Income and Expenditure of Leith Harbour.

INCOME.

Heads of Income.	1841.			1842.			1843.		
	£	s.	d.	£	s.	d.	£	s.	d.
Dock dues	9,741	4	10	7,392	18	7	8,003	8	11
Beaconage and anchorage dues	1,802	18	10	1,711	0	6	1,721	8	5
Berthage and light dues	1,051	7	7	940	12	9	957	0	1
Import and export dues	8,550	4	10½	7,059	11	3½	7,288	0	9
Feu dues and rents	3,151	1	3½	3,099	8	8½	3,498	8	6
Use of graving dock, cranes, &c.	596	1	7	1,334	17	0	412	10	11
Interest	823	12	10	588	7	1	392	3	0
Total . . £.	25,716	11	10	22,126	15	11	22,273	0	7

EXPENDITURE.

Heads of Expenditure.	1841.			1842.			1843.		
	£	s.	d.	£	s.	d.	£	s.	d.
General management and collection of revenues	1,065	19	9	1,080	12	0	1,067	7	6½
Maintenance and repairs of harbour docks	6,212	12	7	6,627	17	8	7,561	9	1½
Dredging harbour	2,212	13	8	1,955	8	10	1,951	14	8
Extension of pier	3,776	12	11	7,428	10	8	2,024	7	9
Charges on property	197	4	6	584	18	5½	351	3	8
Law and parliamentary expenses	211	9	11	889	6	8	181	16	3
Incidental expenses	102	11	10	31	13	0	328	14	3
Payments to the ministers and creditors of the City of Edinburgh, and for the college and schools of said city	7,680	0	0	7,680	0	0	7,456	0	0
Total . . £.	21,459	5	2	26,278	7	3½	20,922	13	8

Acts 39 Geo. III., c. 44; 47 Geo. III., Sess. 2, c. 3.

The payments to the ministers, &c. of the City of Edinburgh are made by virtue of Act 1 & 2 Vict., c. 55, ss. 17 and 18.

Debt on 1st January 1846, 228,374*l*.

W. B. SANDEMAN, *Collector.*

APPENDIX C.

FISHERROW.

No. 25.
Return to Order of House of Commons, of January, 1844.

FISHERROW.

No. 25.

Return by the Commissioners for the Harbour of Fisherrow, in the Burgh of Musselburgh, and County of Edinburgh, in obedience to Circular dated the 1st February, 1845.

Musselburgh, February 7, 1845.

1. BY the ancient Charters of the burgh of Musselburgh, which includes the port of Fisherrow, as confirmed by Act of the Parliament of Scotland of King Charles I., A.D. 1641, intituled "Ratification in favour of the Town of Musselburgh, the right to Ports, Harbours, Anchorages, and Shore-silver, within the bounds of the Burgh and territory thereof," is granted to the burgh. The powers are extended by the Act 3rd of Queen Victoria, cap. 73, intituled "An Act for improving, enlarging, and maintaining the Harbour of Fisherrow, in the County of Edinburgh, June 19, 1840." By this, the Provost, magistrates, and town council of the burgh, are appointed as Commissioners for carrying the purposes of the Statute into effect.

2. There is sent herewith a copy of the map or plan of the harbour.

3. A copy of the last Report by Messrs. Robert Stevenson and Son, civil engineers, Edinburgh.

4. There are not any complaints lodged, of defects of the harbour of Fisberrow.

THOMAS LEES, *Clerk to the Commissioners.*

No. 26.
Messrs. Stevenson's Report on improving the Harbour.

No. 26.

To the Hon. the Provost, Magistrates, and Town Council of the Burgh of Musselburgh, the Report of Robert Stevenson and Sons, Civil Engineers, on Improvement of the Harbour of Fisherrow.

Edinburgh, November 16, 1839.

ON the 9th current, Mr. David Stevenson met by appointment with the Provost and a committee of magistrates and town council of Musselburgh, in order to hear their views, and finally to arrange as to the most advisable position and extent of the proposed works for the improvement of the harbour of Fisherrow, so as to enable the Reporters to prepare the Parliamentary Estimate, previous to applying for the Act, of which notices have been given. The Reporters originally suggested, as the magistrates are aware, two lines for the western pier; one nearly corresponding with that of the present breakwater, and the other, in a position more to the westward. They were induced to propose the most western site, from some engineering considerations:—1st. Because a pier in that situation would inclose a larger area, and consequently afford a greater space for the waves to spend their force, and thus tend to tranquilise the water in the interior of the harbour; 2nd. Because it would include a greater extent of beach for drawing up fishing boats, which was conceived to be important to Fisherrow, as a fishing station; and 3rd. Because it would afford greater space and convenience for working vessels when entering or leaving the port.

The adoption of this more extended scale of works, however, while it would afford these advantages, would at the same time require a greater expenditure than it is believed can be undertaken with the funds which are at the disposal of the town; and as the magistrates seem perfectly satisfied that a western pier, built upon the site of the present breakwater, would afford ample accommodation not only for the present trade, but for any increase that may be expected to follow its erection for a length of time, the Reporters are of opinion that the site involving the smaller outlay of capital, is that which under these circumstances it would be advisable for the magistrates to adopt.

The Reporters have, therefore, in compliance with these views, and at the request of the magistrates, made estimates of the probable expense of constructing a pier on the site of the present breakwater, having a roadway of 22 feet in breadth, which is fully adequate to accommodate the proposed extension of the railway for shipping coals, and the ordinary traffic of the pier; and also the cost of one having a roadway of 18 feet, which is the breadth of the present pier. They find that the erection of a pier having a breadth of 22 feet, together with the expense of forming a roadway to join the present road at the back of the railway depôt, opposite the harbour, including 10 per cent. for incidents, will amount to the sum of 11,885*l.* 18*s.*; and that the works for a pier of 18 feet in breadth, including the connecting roadway, and 10 per cent. for incidents, will amount to the sum of 1,762*l.* 3*s.*

The Reporters have made up these estimates under the impression that it will not be found necessary, from the nature of the ground, to carry the foundations to a greater average depth than the foundations of the works which they formerly executed in the line of the old pier.

ROBERT STEVENSON AND SONS.

No. 27.
Return of the Receipts and Expenditure of the Harbour of Fisherrow, under authority of the Act of January, 1840.

No. 27.

Return of the Receipts and Expenditure of the Harbour of Fisherrow, under Authority of the Act of Queen Victoria, cap. 73, *dated the* 19*th January*, 1840.

Revenue.	1842	1843	1844	Expenditure.	1842	1843	1844
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Tonnage dues .	142 5 8	112 9 6	189 9 4	Interest on borrowed money . . .	250 0 0	270 0 9½	277 10 0
Plankage dues .	2 19 0	3 8 0	2 6 0	Repair of harbour .	31 15 11	19 7 5	1 4 6½
Share dues, inward	170 19 10½	134 0 5	170 2 8	Salaries	40 6 8	54 0 0	54 0 0
Shore dues, outward	16 2 5	12 17 3	26 17 7	Charges	2 8 0	8 10 9	..
Boat dues . .	15 5 0	15 7 6	15 15 0	Lighting of harbour	2 5 3	5 4 0	3 2 3
Ballast dues . .	13 6 0	11 6 8½	4 15 2	Building of new pier	..	..	1685 2 5
Interest from bank	1 15 3	1 11 10	2 5 3				
	362 13 2½	291 1 2½	361 11 0		326 15 10	357 2 11½	2020 19 2½

Debt on January 1, 1846, 7218*l.*

Musselburgh, January 9, 1845.

ROBERT WILSON, *Treasurer.*

APPENDIX C.

MORRISON'S HAVEN.

MORRISON'S HAVEN

No. 28.

Return to Address, &c., dated the 29th July, 1844, relative to Morrison's Haven.

No. 28.
Return to Address, &c., dated the 29th July, 1844, relative to Morrison's Haven.

SIR, *Preston Grange, November 27, 1844.*

IN reply to your letter of the 16th, I beg to state that the authority by which the dues of the harbour of Morrison's Haven are levied is the ancient custom of the barony of Preston Grange, founded on a grant from the Crown of the right of port of Aitchison's Haven, known also as Mill Haven and Morrison's Haven.

The total receipts on account of shore dues for the last three years has not amounted to 40*l*., and has not paid the expense of collection. There has been no expenditure on the harbour for the last three years.

At various periods during the last century considerable sums have been expended by the proprietors of the barony of Preston Grange in improving the harbour; and within the last ten years I have expended at least ten times the sum received as shore dues in improving the harbour, with the view to the exportation of coal, which I carried on very extensively up to the year 1841.

I am, &c.,

To the Hon. Manners Sutton. G. GRANT SUTTIE.

COCKENZIE.

COCKENZIE.

No. 29.

Return to Order of the House of Commons, of the 9th August, 1844.

No. 29.
Return to Order of the House of Commons, of the 9th August, 1844.

SIR, *Cockenzie, March 27, 1845.*

I BEG to acknowledge receipt of your letters of the 1st ultimo, and 22nd instant, and in reply to state, that from the harbour here being private property, there are no Acts of Parliament, or Commissions, or Charters relative thereto, and that permission to land low-duty goods and articles here was obtained from the Lords of the Treasury.

The only maps, plans, and reports respecting the harbour, are those connected with the construction thereof; they are rather bulky, but can be sent up if wished.

I have, &c.,

To the Hon. Manners Sutton. H. FRANCIS CADELL.

No. 30.

Return to Address to Her Majesty, of the 29th July, 1844, relative to the Harbour of Cockenzie.

No. 30.
Return to Address to Her Majesty of the 29th July, 1844, relativa to the Harbour of Cockenzie.

SIR, *Cockenzie, December 5, 1844.*

I HAVE had the honour to receive your letter of the 16th ultimo, and in reply beg to inform you—

That the harbour here was constructed during the years 1833 and 1834, by Wm. and H. Francis Cadell, for the purpose of shipping coals from their collieries.

That from the harbour being private property, general trade is not carried on; but when the coal trade of the port is not interfered with, neighbours are occasionally permitted, on application, to discharge cargoes of barley, oilseed, oilseed-cakes, bark, peats, &c.

That annexed is a return of the dues collected during the years 1841, 1842, and 1843, amounting in all to 197*l*. 0*s*. 1*d*., or on an average 35*l*. 13*s*. 4*d*. yearly.

That a much larger sum is expended than the sum collected, for keeping the harbour in repair, and free of sand, mud, &c.

Annexed is also a sketch of Cockenzie Harbour and the coast adjacent thereto.

I have, &c.,

To the Hon. Manners Sutton. H. FRANCIS CADELL.

Return of Dues levied at Cockenzie Harbour during the Years 1841, 1842, *and* 1843.

Year.	Number of Vessels.	On Barley.			On Cakes and Seeds.			On Peats.			On Potatoes.			On Bark.			On Ships.			Total Yearly.		
		£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*
1841	234	15	8	0		..			..			..			..		15	2	9	30	10	9
1842	125	12	11	9	11	4	5	1	10	3		..			..		14	3	11	39	10	4
1843	129		..		17	11	3		..		1	6	9	2	13	8	15	7	4	36	19	0
	488	27	19	9	28	15	8	1	10	3	1	6	9	2	13	8	44	14	0	107	0	0

APPENDIX C.

NORTH BERWICK.

NORTH BERWICK.

No. 31.
Return to the Order of the House of Commons, of the 9th August, 1844.

No.

Return to Order of House of Commons, of the 9th August, 1844.

SIR,

Council Chambers, North Berwick, February 5, 1845.

I HAVE had the honour to receive your letter of the 1st instant, in answer to the Resolution of the House of Commons, of the 9th August, 1844, stating that Her Majesty, in pursuance of a Resolution of the House of Commons, dated the 9th August, 1844, had been pleased to comply with the prayer of an humble Address for "A return by the Commissioners (or other persons) appointed under the several Acts of Parliament relating to the harbours and havens in the United Kingdom, stating the titles of the several Acts of Parliament, or Charters and Commissions, under which they have acted and now act; also, copies of all maps of the harbour or port in their possession, and of all reports made by the engineers or other officers respecting the port or harbour, together with copies of any complaints made to the Commissioners, &c., of the several harbours and ports, of the defects of the said harbours;" and that you had been directed by Secretary Sir James Graham to desire that such a return should be prepared relative to the harbour of this royal burgh.

I have to state that the management of the harbour lies with the magistrates and town council, and that their authority for acting is that given to them by the Charter of the burgh granted by James VI., and which is dated the 18th September, 1568, and which is indorsed as follows:—

"Producit Coram Dominis scacarii vigesimo quinto die mensis Januarii, 1592.

L. HAY, *Edv*"

"*Edv*. 26 *Martii*, 1656.

"Producit be Wm. Crawford, and ane minit tahrine and recordit in the books of Eccheqr, conforme to the Act yr anent.

W. PURVES, *Cls.*"

We have no copy or map of the harbour except one, (which includes the royal burgh also,) and it is framed and hanging in our Town Hall or Council Chambers; it is the map which was prepared by the Commission of Parliament about fifteen years ago, in order that the boundaries of the different burghs in Scotland might be correctly defined previous to the passing by the Legislature of the Burgh Reform Act, (2 & 3 Gul. IV., cap. 65,) on the 17th July, 1832. It bears, to be engraved by "T. Ellis, 62, Great Russell-street, Bloomsbury."

Our harbour was very thoroughly repaired, enlarged, and improved about thirty years ago. Should you wish to see the report and plans of the engineers then employed, I will have pleasure in desiring them to be sought out and transmitted to you.

We have had no written complaints made to us relative to the defects of the harbour, except one, which was often made verbally, viz., the want of a low-water pier. The erection of such a pier, which could be done without much expense, would greatly tend to the efficiency of the port, and be a great boon to our commerce. Did the burgh funds admit of it the magistrates and council would carry this desirable object into effect, but in the present state of their finances this seems very far distant.

I have, &c.,

To the Hon. Manners Sutton.

JAMES DALE, *Chief Magistrate.*

No. 32.
Letter relative to Reports and Plans.

No. 32.

From the Chief Magistrate of North Berwick, relative to Reports and Plans of the Harbour.

SIR,

Berwick, February 27, 1845.

I DULY received your card of the 7th instant, acknowledging receipt of my letter of the 5th, and stating that "it would be desirable to have copies of the report and plans," relative to the harbour referred to in mine of the 5th.

I have caused a diligent search to be made for the report and plans of the engineers. The plan has been found, but not the report. I deeply regret this; but as it is upwards of thirty years since the improvements were made, it is scarcely to be wondered at, that a document so small should have fallen aside. Unfortunately it was not engrossed in our records.

I send you the plan by the same post which carries this as it can scarcely be understood without the report, you will perhaps think it unnecessary to lay it before Parliament. I shall feel obliged, however, by your returning it, when the purpose with it has been served, whether it be laid before Parliament or not.

There are several places in the coast near this burgh which are well fitted for a Harbour of Refuge, particularly one about a mile to the eastward of this burgh, where there is a natural formed harbour. At the point of the rock there are 3½ fathoms at low water; a cable length off, 4½ fathoms; half a mile off, 6 fathoms; in the stream off the point east and west, 3 fathoms—all with clear sandy bottom. These measurements were taken by the Preventive Guard and Sir George Mackenzie, Baronet, last summer. The place is sheltered from every wind.

I have, &c.

To the Hon. Manners Sutton.

JAMES DALE, *Chief Magistrate.*

No. 33.
Return to Address to Her Majesty, of the 29th July, 1844, from the Chief Magistrate of North Berwick.

No. 33.

Return to Address to Her Majesty, of the 29*th July*, 1844, *from the Chief Magistrate of North Berwick.*

SIR,

North Berwick, November 23, 1844.

IN answer to your letter of the 16th instant, I have to state that the *authority* by which the magistrates and town council levy shore dues, anchorages, &c. at the harbour, is the Charter in favour of the burgh by James VI. and Acts of Council, particularly that of the 11th November, 1751.

The sources of income derived from the harbour having been always classed under one head, I regret it is not in my power to state them under "several heads," as requested in your letter.

The Income and Expenditure for the last three years are as follows:—

	Income.			Expenditure.		
	£.	s.	d.	£.	s	d.
From October 15, 1841 to October 15, 1842 . . .	34	8	1	16	18	2
„ October 15, 1842 „ October 15, 1843 . . .	24	1	5	21	1	2
„ October 15, 1843 „ October 15, 1844 . . .	28	0	9	17	1	2

I may mention that our accounts are regularly made up in the month of October annually, in terms of the Statutes 3 Geo. IV., cap. 91, and 3 & 4 Gul. IV., cap. 76, s. 32.

I have, &c.,

To the Hon. Manners Sutton.

JAMES DALE, *Chief Magistrate.*

DUNBAR.

No. 34.

APPENDIX C.

DUNBAR.

No. 34.
Evidence taken on the 7th Oct., 1846.

Examining Commissioner—Captain WASHINGTON, R N., F.R.S., assisted by Captain VETCH, R.E., F.R.S., Admiralty Engineer.

Present:—Provost MIDDLEMASS; Captain HAY, R.N., of Belton; Bailie D. FRANCE; Bailie P. H. HUME; Counsellor T. HUME; W. DRYSDALE, Esq., of Castlelaw; Counsellor J. KELLIF, M.D.: J. WISON; G. J. BAUMBACK, Collector of Customs; J. DUNGEON; Lieut. BROOMEN, R.N., of the Coast Guard; J. TWYFORD, Esq., of Ritred; S. SAWERS, Esq., of Newhouse; J. RICHARDSON, Chamberlain of Dunbar; W. H. RITCHIE, Town Clerk; JAS. RITCHIE, ditto; J. MASON, Land Surveyor; A. S. SAWERS; J. LORN: J. DUNLOP; J RAMAGE, Harbour-master; R. FENDER; J. SANDERSON; C. L. SAWERS; R. S. MORTON; G. JOHNSTON; with a number of fishermen and townspeople.

JOHN RICHARDSON, chamberlain of Dunbar, examined.—Has been chamberlain for 11 years. The harbour of Dunbar was formerly governed by charter from King James VI., dated 1618, and now by Act of Parliament; the magistrates and Council, with a Committee of their number acting under them, superintend the affairs of the harbour; the minutes of this Committee are kept by themselves, distinct from the other minutes of the town's affairs, and reports are made from time to time to the Council. The agent for Lloyd's is one of the Committee; the harbour-master reports on the state of the harbour to this Committee; the Committee meet when required by the Convenor. He keeps the harbour accounts separate from the other accounts of the burgh; these accounts are audited by another Committee of the Council. The revenues of the two harbours are paid into the general accounts of the town; the revenue of the town is about 1200*l*. The Council is allowed, by Act of Parliament, to borrow from the town's ordinary funds for the maintenance and improvement of the harbour, which sum then forms a debt upon the harbour; this was formerly done for repairs upon the old harbour, but within the last 20 years this debt, amounting to 333*l*., has been paid off from the revenue of the harbour; 4500*l*. was lately borrowed for the erection of the new harbour; this sum was given to the Board for British Fisheries, who then bound themselves to build this harbour; the Board agreed to advance two-thirds of the cost if the town would give the other third; the town performed their part of the agreement. No account has been rendered by the Fishery Board as to the manner in which this money has been expended. There was a larger sum than usual laid out upon the harbour last year; this was in a great measure owing to the town being obliged to pay part of the expenses of the engineer; this gentleman acted under the authority of the Board of Fisheries.

Provost MIDDLEMASS said that the Board of Fisheries consulted with the town, but refused to be guided by the information given them. The engineer only partially examined the fishermen of the port, but not so fully as he ought to have done; that he, the engineer, did not visit Dunbar above five or six times.

Mr. RICHARDSON.—The accounts are audited by a Committee of Council, agreeably to Act of Parliament; they are not published in any newspaper. The treasurer and clerk of the burgh are not the same person. This mode of managing the affairs of the burgh, and the constitution of the committee of management of the harbour are agreeable to the public, at least no complaints have been made. The council consists of 20 members; three of these act as a committee for the harbour. He lately transmitted an account to the Secretary of State. and can vouch for its correctness; the debt of the burgh is the same as when that account was rendered, with an addition of interest; the debt of the burgh now amounts to 9090*l*.; the debt of the new harbour is 4500*l*., and, with interest, is 5832*l*. 0*s*. 5*d*.; the revenue from the harbours is about 120*l*. a-year.

Income and Expenditure for the Harbour of Dunbar for the Years 1841–6.

	1841			1842			1843			1844			1845			1846		
INCOME.	£.	*s.*	*d.*	£.	*s.*	*d.*	£	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*
Anchorage	75	10	0	57	10	0	72	0	0	63	10	0	61	10	0	56	15	0
Ballast	26	10	0	15	0	0	20	10	0	22	10	0	28	0	0	33	0	0
Tiends	22	7	2	65	8	11	40	4	8	35	11	6	22	0	0		..	
Curing Stances . .	30	19	6	29	4	6	11	5	0	10	10	0	4	0	0	9	10	0
Totals . . .	155	6	8	167	3	5	143	19	8	132	1	6	115	10	0	99	5	0
EXPENDITURE.																		
Old Harbour . . .	95	12	10	20	17	4	27	0	8	24	2	5	85	0	11	61	11	10
New Harbour . . .	52	10	10	54	5	6	20	4	4		..		21	1	0	186	10	7
Totals . . .	148	3	8	75	2	10	47	5	0	24	2	5	106	1	11	248	2	5

WILLIAM H. RITCHIE, conjoint town clerk.—Keeps the minutes of the magistrates and Council, and when written reports are laid before the Council by the Harbour Committee, they are generally entered in minute-books. Minute Book produced, and found accurately and cleanly written. Nine members form a quorum of the Council. The Council meet regularly once a-month, but oftener if required. The Harbour Committee has been desirous to get the new harbour legalized for the entry of foreign vessels, but this has been refused. No attempt has been made to separate the management of the harbour from that of the other affairs of the town.

Mr. HUME.—This cannot be done, as the debt due by the town is partly secured over the harbour.

WITNESS.—There is no check upon the Council should they lay out a sum upon the harbours which is not authorized by the Local Act. No complaints have been made to the Council as to the management of the harbour, but frequently it has been said that the improvements fall short of what they ought to be. About the year 1840, the fishermen resident in the ports along the Frith of Forth, complained that the old harbour was neither sufficiently large nor secure for their traffic during the

APPENDIX C.

DUNBAR.

No. 34.

Evidence taken on the 7th Oct., 1846.

herring-fishing season, and applications from about 1500 of them were sent to the Board of Fisheries in favour of a new harbour. After much correspondence, agreements were entered into between the town and the Board, whereby the latter agreed to build a harbour at Dunbar, provided the town would advance 4500*l.*, being about one-third of what was the estimated cost. It also formed part of the arrangement to shut up the present entrance to the old harbour, and form a communication between that and the new one; but the sum at the command of the Board being found inadequate for this purpose, this part of the project was abandoned. Mr. Mitchell made out the plans for the new harbour; being the engineer for, and recommended by, the Board. His plans were agreed to by the town to avoid the expense of another engineer, as Mr. Mitchell was the ultimate referee. It was at one time intended to make the entrance through the cavity called "King Edward's Entrance," and a long correspondence took place upon the subject, but the present entrance was ultimately adopted, as the other was found to be too near the shore. For want of funds, all the improvements contemplated were not gone into. The Board of Fisheries has been memorialized to have further improvements made upon the entrance, but have not agreed to these, and there is little hope of their agreeing. The average number of boats attending this station during the herring fishing is about 300. They can enter the new harbour at half-tide; but frequent complaints are made against the narrowness of the entrance, and, in consequence of heavy swells at its mouth from the north-west, it is dangerous to enter. No accident has as yet happened to any boat. About 18 vessels were in the new harbour this last season.

Provost MIDDLEMASS.—Fifty French vessels might have come in had they been allowed, and their purchases of fish would have been very beneficial to the fishermen, and a source of wealth to the country.

WITNESS.—The town is anxious for a platform made on the outside of the entrance, so as to ensure water and accommodation to vessels wishing to discharge their cargoes when low water prevents them entering the harbour; at all events the entrance ought to be widened. The engineer has been told so, but the Board refuse to do it, and ask, as a first condition, that there should be a departure from the collection of tiends on fish, which the town cannot do, in consequence of the heavy debt incurred at the erection of the harbour. The first thing to be done is to widen the entrance, and then to open up the communication between the harbours.

Mr. C. L. SAWERS here stated that this would do harm without a jetty.

Provost MIDDLEMASS.—Two boats were nearly wrecked in consequence of the narrowness of the entrance, and the waves coming directly upon it. Thinks the breakwater ought to have lain more to the north-east than it does, and that more facing is wanted upon the rocks.

WITNESS.—Without a jetty it will be impossible to have steam-vessels at this port; these are much wanted, even with the increased internal communication now afforded by the North British Railway. Cargoes of cattle are frequently sent from Shetland to this port. Informed by Ramage, the harbour master, that there were five last year, and that cargoes of corn from the north, bound for Leith, have frequently to put into Dunbar, from the state of the weather, and they are often sold here.

G. J. BAUMBACK, collector of customs.—For the last year there have been 323 vessels, tonnage 14,427, put into Dunbar; 61 vessels, tonnage 2344, outwards, with cargoes; 8 for foreign parts, tonnage 1033; the registered vessels at Dunbar are 62, tonnage 1291. There have been 62 wind-bound vessels during the year. Has heard it said that vessels prefer the old to the new harbour. The new harbour is not adapted for business, the quays being too high. They are high enough for an Indiaman.

Mr. MASON.—They are 6 feet above high water. The tide rises 18 feet.

WITNESS.—No legalization is required for the discharge of foreign cargoes in the new harbour, as no vessels could discharge at the quays, as the waves, which sometimes come over the pier, would swamp a vessel. The harbour is adapted only for boats; and thinks the sum laid out to render it fit for a shipping harbour uselessly expended. His opinion is, that the town expected a number of boats' crews to take up a permanent residence at Dunbar, and that originally it was intended only as a fishing harbour.

Provost MIDDLEMASS, from the first, understood that the harbour was to be made suitable for the coasting trade. A jetty is wished both for shelter and convenience. All vessels pay dues in the old harbour; and if the communication be made, the Fishery Board will ask exemption from these to vessels going into the old harbour.

JAMES RAMAGE, harbour-master.—Has been 30 years in Dunbar, and 7 years harbour-master. Has often seen heavy gales of wind; and after removal of the booms from the old harbour, has found that vessels could not be secured in the harbour. The pier, to which one end of the booms was attached, was thrown down by a heavy gale. They were tried at another place, but it was found they could not resist the pressure of the water at that place. Is of opinion, that the only thing to save the harbour, and the vessels which may be therein during a gale, is to rebuild the boom-pier, the width of which is 46 feet. Does not think that opening a communication with the new harbour would make any material difference. There is a strong run of water into the old harbour. There has been a greater run of water into the old harbour since the new harbour was built, and heavy seas, when the wind is south-east.

The Right Honourable Earl of HADDINGTON here entered the room.—His Lordship said he considered Dunbar as by far the best place on the coast, in every respect, for a harbour of refuge on a large scale.

ROBERT FENDER, shipmaster, Dunbar.—Has resided all his life at Dunbar. Was brought up as a seaman at that port. At one time sailed in and out of the harbour at least weekly. Has sailed into the old harbour since the new one has been built, and discovered no difference. Has witnessed more disasters before the new harbour was built than subsequently. The old harbour is safe when booms are on it. The entrance to it was always dangerous, and does not think there is greater difficulty in taking it than formerly. Never came into the new harbour with a vessel; but does not consider it safe either for vessels or boats until the entrance be widened. It is so narrow that boats cannot use their oars; and has himself, in consequence, frequently towed them in. When the wind blows from the north-east there is a heavy swell. Were the rock cut away, there would be two fathoms water at the entrance. This is the opinion of most fishermen. Several of the harbours

APPENDIX C.

DUNBAR.

No. 34.
Evidence taken on the 7th Oct., 1846.

along the coast are as difficult to be taken as Dunbar in certain winds. He would rather take Dunbar than North Shields Bar—not being sufficiently acquainted with the latter. The only conveniences of the intercommunication will be, that in easterly winds, when vessels could not be taken out by the old entrance, they might be towed out by the new one. Boats are sometimes prevented lying alongside the quay of the new harbour from the quantity of water which comes over the pier. Is of opinion that a harbour of refuge could be advantageously made, and would be of great benefit to the shipping interest, as vessels in a gale of wind could take such a harbour, whereas they have now to run up the Frith. Six Greenland vessels belonged to this port at one time. Has often known vessels being lost from not having a harbour of refuge at Dunbar. Vessels have frequently to run back to the Frith, whereas they could have taken shelter in a harbour of refuge at Dunbar. North Berwick is not so suitable a place for one, the water there being too shallow. Does not think Eyemouth so good a situation as Dunbar for such a harbour, as the ground does not afford good anchorage. A harbour of refuge at Dunbar would be useful both to northward and southward-bound vessels. Has seen many wind-bound vessels in Dunbar.

Mr. HUME has seen 20 laden with grain wind-bound at one time. Does not think there would be a greater swell or current if the communication between the two harbours was made. The Dunbar bay is very deep. Has seen a Leith smack three days in beating out of it

A. COMB, fisherman and pilot, Dunbar.—Has brought no vessels into the new harbour, as he considers the entrance too narrow and crooked. In westerly gales a great number of wind-bound vessels take shelter in Dunbar. Has seen as many as 40 at one time. Many more would do so, if there were greater accommodation. Thinks the entrance into the new harbour should be made straight, and not crooked, as at present. A vessel was much damaged in the new harbour; but thinks this might have been prevented by branders. Has seen much damage done in the old harbour when the wind was from the north-east. Vessels have often been broken from their moorings. This has occurred before the booms were removed. Thinks they ought to be replaced. The new harbour should be deepened, as it is useless at present. The tides set east and west. No tide runs past the new entrance, but there is past the old, and at the rate of three knots an hour. Does not think there is greater difficulty in taking the entrance to the old harbour since the new has been built. The communication would spoil both harbours, without gates being put. Other fishermen of the port think so also. Has seen boats go out of the new harbour when they could not have left the old. A harbour of refuge would prove a benefit to trade. Does not think the entrance to the old harbour should be closed, as in westerly winds vessels might find difficulty in making out of the new harbour. New heads are required to admit of booms at the proposed communication.

Here a difference of opinion arose as to the cause of the boom-pier being thrawn down.

Mr. SAWERS said it was a high tide and heavy sea.

COMB thought it was a sloop which, being driven from her moorings, forced out the posts of the pier.

Mr. HUME was of opinion that it was occasioned by the cleats being removed from the booms.

WITNESS.—A harbour of refuge would be very beneficial to the north country trade. Nine vessels were wrecked between Dunbar and St. Abb's Head during one year, all of which might have been saved had there been a harbour of refuge at Dunbar. Does not think a harbour of refuge is so much required at North Berwick as at Dunbar, as vessels are comparatively safe after they have passed the Bass Rock. Does not consider Eyemouth a suitable place for such a harbour. From his past experience, he knows of no place so well adapted for the erection of one, or where it is so much required, as at Dunbar. Many vessels would then take shelter in Dunbar which have now to run to the Frith. There is certainly no need for a harbour at Aberlady, nor did he see any necessity for one at St. Margaret's Hope, as from its position it naturally afforded shelter. Besides, it was too far up the Frith, about 40 miles. Shateraw is objectionable, from the water being too shallow. It is five fathoms outside the rocks.

A. RICHARDSON, fisherman, Dunbar.—Has known Dunbar for 56 years. Agrees with all that Comb has stated. Has found the entrance into the new harbour very difficult indeed. He never saw so bad a one—being both narrow and crooked. Does not think that cutting off the rock on the outside would admit too much sea. Has heard all that has been said about a communication between the old and new harbours; but if it be adopted, there must be either gates or booms placed across. Thinks a harbour of refuge would be of advantage to the shipping interest; and that all vessels in a gale would take it in preference to running to the Frith. Knows Eyemouth and North Berwick, and does not consider either so favourable a place for such a harbour. One at Dunbar would be found very convenient for Queen's vessels, particularly in war. One is much required for the shipping generally, as they are much exposed upon this part of the coast; and it is certain that much life and property would be saved were there one erected at Dunbar. Has seen fully ten vessels wrecked in one day, which would have been saved had there been a harbour of refuge. Was at one time on board the "Rover," sloop-of-war, on foreign service.

Several pilots agreed with the foregoing witnesses.

Lieut BRUEMAN, R.N. of the coast-guard has observed that boats must lie outside the new harbour till quarter-tides allow them to enter. About 50 vessels pass daily for Leith. One morning, lately, about 120 wind-bound vessels sailed out of the Frith. Is of opinion, that if there had been a harbour of refuge at Dunbar, two vessels wrecked last year might have been saved. Does not think there should be any communication, at least, not without booms between the two harbours. The entrance to the new harbour is much too narrow for either boats or vessels. Were it widened and deepened, boats could enter at all times. Were a pier of piles, with stones between, placed outside the present pier, the swell would be broken and would be of advantage to vessels discharging their cargoes.

SIMON SAWERS, Esq., of Newhouse.—No green water comes over the pier of the new harbour, but only spray. 600 boats can lie in the harbour, which is dry at low water in spring tides.

Capt. HAY, R.N., of Belton, concurred in all that had been stated with respect to the deficiencies of the harbour in its present state, and as to the great outlay upon the new harbour, and the little corresponding benefit derived from it. He would also specially call attention to the favourable position of Dunbar as a site for a harbour of refuge; it should be remarked, that the winds in the Frith of Forth generally blow right up or right down, so that in heavy weather vessels could not work up to Leith Roads, and therefore required shelter further down. Occasionally vessels are blown off after

APPENDIX C.

DUNBAR.

No. 34.
Evidence taken on the 7th Oct., 1846.

coming thus far and are obliged to seek shelter in the harbour, all of which might be obviated by an asylum harbour at Dunbar, and for the erection of which the facilities are very great.

J. MASON, land surveyor and engineer.—The projecting rock at west end of the pier of the new harbour should be taken off to allow the water to expend itself, as the damage done to the pier was all at that point, and not at the east end. It was proposed to deepen the entrance. Mr. Mitchell's first plan was, to have it four feet at low water, but from the want of funds, he believes, this was not effected. Did not understand there were less than two feet of water at low water. It would require about 500*l.* or 600*l.* to make the communication between new and old harbours, and 200*l.* more to cut the rocks on either side. This sum does not include a draw-bridge, which would cost about 200*l.* more, say in all 1000*l.* He does not anticipate any difficulty in making it. Was present when the new harbour was built, and took the superintendence for three months. The contract was entered into between the Fishery Board and Messrs. David Lyon and Co., of Glasgow. The stone was taken from Dunbar quarries. Red and white sandstone is peculiar to this neighbourhood. There is plenty of stone about Dunbar to build a larger harbour than the new harbour, but not enough for a harbour of refuge. The supply for this purpose must be got from the Frith of Forth; the packing for a harbour of refuge would be found in large enough quantities on the property of the Earl of Lauderdale, which adjoins the present new harbour. The area of the proposed large harbour would be about 50 imperial acres. It would cost about 300,000*l.* The foundation of the new harbour is upon rock; the outside and inside walls of the pier are of ashlar work, four feet thick each, and packed with large rubble. It is 46 feet thick at the bottom and 36 at the top; the height is 22 feet with a parapet of 16 feet, but still this is not sufficiently high to prevent the spray washing over; the entrance is 50 feet wide at the narrowest parts, and in some places it is 60 feet. Is acquainted with other harbours where the entrance is as narrow. This harbour took two years and a-half in building. The works encountered heavy storms when in an unfinished state, and were in consequence thrown down three times. It is built according to a modified plan. The excavations were made by blasting and picking. There was no natural opening for an entrance; it was cut through a solid whinstone rock down to low water. Has seen great inconvenience from the narrowness of the entrance and the projecting rock. He would propose cutting away the pointed rock to get more immediately to the deep water, and prevent the broken water; this would cost about 1500*l.* He would also recommend that a quay be made at the entrance for landing goods and fish. It could be made of timber, the best and easiest method of breaking the seas, where steam-boats and other crafts might discharge their cargoes during three-fourths of the year. It would also break the run of the sea into the harbour. Does not think that the communication between the two harbours would cause much current. It should, however, be made close to the rock. He would not recommend laying out money upon the old harbour, but he would most anxiously upon the entrance of the new harbour, where there is a fine bottom and deep water, and more protection from all the heaviest seas.

No. 35.
Return relative to Acts of Parliament, &c.

No. 35.

Return in obedience to the Resolution of the House of Commons, dated 9th August, 1844, by the Magistrates and Council of the Royal Burgh of Dunbar, Commissioners appointed under the Act after mentioned for regulating the Harbour of the Burgh.

I. The title of the Act of Parliament under which the Commissioners have acted and now act, is "An Act for the further improvement and maintenance of the Harbour of Dunbar, and other Public Works within the Burgh of Dunbar, and for the better supplying the said Burgh with water, dated 21st June, 1827.

II. There is sent copy of a map of the old harbour with the enlargement lately made thereto, by contract between the Honourable Board of British White Herring Fishery and the Commissioners of Dunbar. The remarks at the end hereof will show the necessity for some further improvements being made on the harbour for the convenience and safety of the trade of the Port and Frith.

III. There are sent copy Report by Joseph Mitchell, Esq., Engineer to the Fishery Board, dated 27th, January, 1841; copy Report by James Walker, Esq., to the Treasury, dated 19th April, 1843, &c. Various other Reports on this important harbour are in the hands of the Treasury.

IV. There are sent Acts of the General Convention of Royal Burghs of Scotland, held at Edinburgh, the 9th day of July, 1844. Act Twelfth refers to the Harbour of Dunbar, and the petition in its favour is appended to the Acts of Convention.

V. No written complaints against the harbour are known to exist, but innumerable verbal complaints have been made, stating the defects of the harbour as a place of shelter in case of storm.

REMARKS.—From the extensive herring fishery carried on at Dunbar, the old harbour was found totally inadequate to afford accommodation to the vast number of stranger boats daily frequenting it at that season; and from the bad construction of its entrance, it was almost inaccessable in time of storm. The petitions of upwards 2000 fishermen and of a number of seafaring merchantmen induced the Honourable Board of British White Herring Fishery seriously to consider the propriety of making additional accommodation for fishing boats, and at the same time a safe and ready rendezvous for fishermen to fly to when overtaken by storm at the mouth of the Frith of Forth, where the supply for the Edinburgh, Glasgow, and other markets is obtained.

Such a harbour has now been completed at the joint expense of the Fishery Board and the town of Dunbar, and will be of the very greatest importance to the fishing trade; but from the want of means it will not be of that benefit to the merchant service which was at first contemplated.

By reference to the plan, it will be observed that there is a considerable depth of water at the harbour mouth, and completely protected from storm by the rocks on the outside. Were the new harbour mouth deepened, or were there a small jettee erected near to it, so as to take advantage of the deep water, or were a small wharf formed along the ridge of rocks at the harbour entrance, as shown on the plan, from A. B. to C., there would be at all times of the tide ample accommodation and shelter for merchantmen when overtaken by storm, as they frequently are, at the mouth of the Frith.

The whole expense of any one of these improvements, it is thought, would not cost 3000*l.*, and when the fearful amount of shipwreck which annually happens on the coast is taken into account, it would, independent of every other consideration, be an act of the greatest philanthropy to make the

No. 35.
Return relative to Acts of Parliament, &c.

erection. The Commissioners have expended every farthing of their means, and have got into very considerable debt by advancing their quota to the Fishery Harbour, and have it not in their power to raise any further sum; but some arrangement might be made by which the dues received from vessels taking advantage of the shelter should go towards the extinction of the debt.

Another great public benefit would arise from this improvement. Steam-boats from Dundee, Montrose, and indeed from all the important towns in the north of Scotland, would find safe accommodation, so that they might land their passengers at Dunbar, who could take advantage of the North British Railway, which passes close to the town, for going either north or south. And the mail-bags for the north might be crossed from this harbour by steam, which would be a very considerable saving of time to the trade of the country.

Dunbar has also been often looked to as a very important station for a harbour of refuge on an extended scale. This proposed harbour is also shown on the plan, and includes, with the present harbours, an area of about 60 acres. The ground is hard, so that there is no danger of silt. A number of naval officers of high standing have visited and highly approved of this refuge harbour; among others may be named Lord John Hay, Captain Dundas, &c.,

Humbly reported by
CHR. MIDDLEMASS, *Provost.*

No. 36.

Report of JOHN SMEATON, Esq., C.E., F.R.S., *on the Harbour of Dunbar.*

No. 36.
Smeaton's Report on the harbour.

Austhorpe, June 25, 1772.

THE harbour of Dunbar appears from its form to be well adapted for the security of vessels lying therein; and as it is situated in the bottom of a bay, exclusive of the trade that is usually carried on there, it becomes of consequence to the security of vessels trading on this coast; and its principal deficiency, in both these views, is the want of a good access particularly in going into it; and this is not owing to an improper course or direction of the entry from the bay, but from the narrowness of the passage, which is rendered in effect still narrower from the sloping form of the rocks on the starboard or N.W. side going in; to avoid which, vessels are obliged in prudence to keep nearer to the pier than they otherwise would do, and by this means, by the recoil of the sea from the rocks, are often driven against the pier or upon the sloping rocks that are sunken and hid. To remedy this inconvenience as much as possible it has been very properly proposed to cut off a certain part of the slope of the rocks down even with the bottom of the rest of the passage, and to build the face up above high-water mark, as shown at A A in the plan; by which means, as the passage will not only be actually widened full five yards in the narrowest place, but by giving opportunity to vessels to see everything that can hurt them, they may safely keep several yards further from the pier than they could otherwise have done; the passage thereby in the narrowest part being rendered from about 45 to 60 feet wide; at the same time, the sea being prevented from breaking upon the sloping rocks, it will recoil with less force than at present, and the vessels will be less subject to be carried from side to side for want of sufficient way through the water. Lastly, this new pier or facing to the side of the entry being carried up sufficiently above high-water mark, it will enable assistance to be given by throwing a rope on board from the most projecting point thereof, so as to tow in vessels when they do not come in with sufficient fresh-way to keep them clear of either side of the entry.

With the same view, it would be well if a pier could also be carried out upon a ledge of rocks (which are dry at low-water) on the S.E. side of the entry, from the north angle of the present pier to the Beacon Rock. This would not only defend the passage from the surge of the sea, but, by its projection, also enable assistance to be given by throwing a rope on board on the larboard side of the ship, of which there is always an equal chance of its being preferable, by its being nearest, and still more effectual when it can be done on both sides. To this, however, may reasonably be objected the great expense that must necessarily attend the execution of a pier of sufficient bulk and strength to stand in this place the full stroke of the sea. However, to take advantage of that part of the utility of a S.E. pier which consists in giving assistance by a rope, I have contrived a gangway to extend itself in the same direction as far as the Beacon Rock, as shown by the dotted lines in the plan, whereby any competent number of men will be able to give the same assistance, by heaving a rope on board, as could be done from a stone pier, and which is contrived on principles so simple that it may be executed at a very moderate expense. This will be sufficiently explained by a design on purpose (see plate 23), showing how the same is to be executed; and indeed, had I not a good deal of experience in the fixing of temporary utensils in the building of the Eddystone Lighthouse, I should have been very dubious in proposing a structure seemingly so slight to stand the violence of the sea. But there I learnt, that where the force of the sea is to be rather eluded than resisted, the less matter is opposed to its action the better, provided that this be but fixed in the firmest manner. I believe the whole of the design will occur from the plan, save the manner of fixing the iron bolts into the rocks, which is not proposed to be done with lead, as that is perpetually working loose, but in the following manner:—Round holes, about 18 inches into the rock—more or less according to the firmness thereof—are to be bored with a jumper of 1¼ inch diameter; to these the eye-bolts are to be forged, a very small matter taper, and larger, so as to drive tight to their proper depth with an iron maul; if they happen to be a small matter too small, then strips of plate-iron put in along with them will make them to drive firm, and the rust will fix them from drawing.

Respecting the proposed pier or wharf (A A in the plan), as it will receive the full stroke of the sea with a south-easterly wind, it will be necessary to be built very firm, and I believe it will not fully answer the end if the ordinary seas break over it. I therefore propose it to be raised 9 feet above high-water at spring-tides, that is 22 feet above the low-water-line at the pier-head, but it may decline in height, as it runs south-westerly towards the land. This height will carry it considerably above the rocks where it is built, and, therefore, instead of so large a quantity of backings as will be necessary to make the whole good to that level with the land, I have proposed it to be built upon the back side, as per section, *fig.* 3.

The rocks (B) at the foot of the pier are to be taken away, as above shown, before the pier is built; and when it is finished, they are to be cut off smooth according to the line A.

APPENDIX C.

DUNBAR.

No. 36.
Smeaton's Report on the harbour.

The bare stones of the pier (see face view, *fig.* 4) are not proposed to be all on the same level, a there shown, but the rock cut to give the stone its proper bearing.

The face (*fig.* 4), if you can procure the freestone at a moderate price, will be best done according to the specimen; but if you work with rough stones, the more nearly they are laid conformable to the same idea the better; and the platform at top should be laid on with the best mortar. As I cannot well judge of the prices at which the materials can be procured, and the work executed at Dunbar, I content myself with making an estimate of quantities as follows, which may be filled up after proper workmen, &c. are consulted:—

ESTIMATES.—*The Pier.*

To cutting the rock according to the line in the plan, 786 cube yards, at . . .
To building in the whole pier, 2770 cube yards, at . . . . . .
To freestone in the face and platform, reckoned at a medium, 2½ feet in thickness, reckoned extra in its value in the solid of the pier, 26,250 cube feet, at .
To posts of wood or stone (if thought necessary), as also for lime, &c. . .
To contingent expenses at 10 per cent. on the above articles . . . .

Total of the pier . . . . £

The Gangway.

To fir timber, 942 say, measured neat in place, 1000 cube feet, at . . . .
To iron-work, 19½ cwt., say 1 ton, at . . . .
To a large stone for fixing the end of the gangway to the parapet of the present pier, 30 cube feet, at . . . .
Contingencies on the above at 10 per cent. . . . .

Total of the gangway . . . . £

J. SMEATON.

No. 37.
Mitchell's Report on the new Harbour.

No. 37.

Report by JOSEPH MITCHELL, Esq., *Engineer to the Board of British White Herring Fisheries.*

January 27, 1841.

IN compliance with the instructions of the Board contained in your letter of 2nd December last, I proceeded to Dunbar, and met Provost Middlemass and the other gentlemen interested in the improvement of the harbour, with whom I examined the ground, and who furnished me with every information and data necessary to form an opinion in regard to the contemplated works. I caused, also, sections along the Castle Haven and in other directions to be made, so as to enable me to calculate the quantity of excavation and masonry required. I also examined the ground a second time, as an entrance different from that originally proposed was suggested, and was considered by some of the parties at Dunbar to be rather an improvement on the original plan. I have now given the whole subject my best consideration, and beg to report—

That it is my opinion that the Castle Haven is the proper and best situation for the harbour of Dunbar. The severest storms in that quarter range from the east, north, and north-east, and south-east, and the projecting heads of the battery rocks, and the rocks of Dunbar Castle, by constructing a breakwater between them, afford the means of securing shelter in this bay for a harbour, with an area of more than usual extent. Indeed had an entrance been contrived for the harbour more exposed than any other, it is that which now exists, bearing as it does openly on the heaviest seas which roll along this part of the coast. The entrance on the other side, at the point called King Edward's Entrance, is much safer from the heavy swell; the outer end is in immediate deep water, and the projecting coast towards Sea Cliff Point and Tantallan will, in some measure, protect it from the swell which must occasionally occur with storms from the west and north-west. It was suggested to me that the entrance might be more advantageously constructed without the ruins of the Castle by excavating a passage through a narrow cleft of the rocks called the "Blue Stone Passage;" but after a good deal of examination of this point, I have come to the conclusion that it is decidedly inferior to the other, inasmuch as the breakwater inside of the wharf wall would necessarily have to run in a continuous line with it, and the swell which entered at the mouth of the harbour would thus be directed and pass along the most valuable and best frequented part of the interior, causing, of course, considerable commotion and disturbance among boats and vessels lying attached to the wharf. By the King Edward's Entrance, while it is in itself naturally more protected, any swell entering would spend itself in the sloping part of the harbour, and, in my opinion, create little disturbance in the interior. The clefts in the rocks also, called the "Blue Stone Passage," will tend greatly to break the heavy swell which may approach the proposed inner entrance.

I have, therefore, adopted the King Edward's Entrance as the best, which, with the other works, will make Dunbar Harbour for every purpose, both of the fishery and commerce, perhaps the best, considering its exposure, along the east coast of Scotland. It will afford an area of no less than 4¾ acres in the Castle Haven, and at a future time the inhabitants of Dunbar, at a very little expense, may secure in the old harbour an excellent and extensive wet dock of 2¼ acres.

In the construction of the works, the breakwater between the Castle Rocks and Battery Rocks must be of the most substantial workmanship, having a sloped sea-wall with a protecting parapet 12 feet high. Inside of this there will be an extensive range of wharf no less than 1000 feet in length for the loading and discharging of vessels.

In front of the wharf I propose a space of 90 feet average to be excavated, so as to afford an average depth of water at spring tides of 15½ feet, and the space from thence to high-water mark sloped up in a regular manner.

The entrance passage must necessarily be excavated to a considerable depth; and in order to protect vessels as they approach it from being damaged by any projecting points of rock, I have calculated

No. 37.
Mitchell's Report on the new Harbour.

on facing the whole with a frame-work of timber fenders. A very trifling expense in the construction of a timber wharf will afford on the east side of the entrance accommodation, and deep water at all times for such steamers as may have occasion to approach Dunbar.

I estimate the expense of constructing the new harbour in the Castle Haven at 9702*l.* 8*s.* 3*d.*, and if the present entrance is shut up and the old harbour made available, the expense will be increased by 1230*l.* 9*s.* 8*d.*, making a total of 10,932*l.* 17*s.* 11*d.* This estimate may be considered high, comparatively with the outlay hitherto made by the Commissioners at any one place, but I am quite satisfied that the construction of a work of this magnitude, in a situation so peculiarly favourable as Dunbar, will be more advantageous to the public generally than minor works of a less costly, but at the same time of much more contracted and local utility.

I have, &c.,

(Signed) JOS. MITCHELL.

No. 38.

No. 38.
The Secretary of the Admiralty to the Provost.

The Secretary of the Admiralty to the Provost of Dunbar.

August 23, 1842.

I HAVE laid before my Lords Commissioners of the Admiralty the Petition of the Magistrates and Council of Dunbar, praying that a survey of the harbour and locality of Dunbar may be made by a Government engineer, and have to acquaint you, that as my Lords are of opinion that Dunbar offers great facilities for making a Breakwater Harbour, they will, if the parties interested are disposed to pay for the previous survey, employ Mr. Walker, the engineer upon it, who is going next month to the Caledonian Canal.

I am, &c., JOHN BARROW.

No. 39.

No. 39.
Walker's Report on the new Harbour.

Report by JAMES WALKER, Esq., F.R.S., *on the Sufficiency of the Works at Dunbar Harbour.*

SIR, 23, *Great George Street, April* 19, 1843.

THE instructions I received from you on behalf of the Lords of Her Majesty's Treasury are, that I visit Dunbar, and after surveying the works of the proposed new harbour there as contracted to be built by Messrs. Lyon and Collie, report my opinion of the sufficiency of the same, the contractors having represented to the Commissioners of the White Herring Fisheries of Scotland that they consider the pier, as planned by Mr. Mitchell, the engineer to the Board, too weak and too low to resist the force of the sea.

Previous to my going to Dunbar I waited in Edinburgh on Sir Thomas Dick Lauder, at his request and received from him certain explanations, together with the contract and specifications on the work, and on my arrival at Dunbar on the 7th, I attended at their request a meeting of the provost and magistrates of that town. On the following day I surveyed the works, and with my assistant, Mr. Deane, took such observations and measurements as I considered requisite, Mr Mitchell then attending having been thought by you unnecessary.

Having since considered the subject, with the reports and other documents, and the observations made by Mr. Lyon both in writing and to me while upon the survey, I am of opinion that the wall as contracted for, will, if carefully built, be sufficient to resist the force of the sea; in other words, that if the contractors only do their duty, and take care in the execution of the work to use good materials, making all the parts solid, the joints good, and well connecting the work to resist the heavy seas to which they are aware it will be subjected, their apprehension will prove groundless. My opinion in this respect agrees with that of Mr. Mitchell and Mr. Gibb, and is confirmed by the various precedents of all the walls that have been adduced; at the same time it is proper to say that the Dunbar stone which is being used is about 15 per cent. lighter than granite or heavy whinstone, and as the wall will be exposed to very heavy seas during north-easterly gales, there is not much to spare in point of strength; so that, unless the work be properly attended to and executed, Messrs. Lyons and Co.'s fears may be realized.

I would remark also that the sea will rise up the regular sloping concave face of the sea-wall, as its top is only 17 feet 6 inches above an ordinary spring tide, or 15 feet above a very high spring tide, the seas will occasionally come over the walls with great force, tending to disturb the paving of the road inside, and to the discomfort of vessels in the harbour, which must on such occasions draw away from the quay berths to prevent their being swamped, and this removal may be inconvenient when the harbour is full. In heavy storms the water is said to come in considerable quantities over the battery wall, which is 3 feet higher than the proposed wall, besides having the advantage of being shorter, with an open end, the part referred to being also rounded. These advantages are at the same time, in some measure, counterbalanced by the deep water immediately in front of the battery wall, as the shoal water and rocks in front of the proposed pier will tend to break the force of the seas.

An addition, therefore, of 10 feet to the height of the wall would give additional security and protection, and so a cartway 20 feet wide would be more convenient than one of 16 feet, the contract width, which is barely sufficient for a cart to turn in with safety.

The addition to the strength and height of the wall is estimated by the contractors at 4500*l.*, which I find from calculation to be at nearly the same rate or price as the contract; the expense of an addition of 4 feet to the width of the broadway, which is not contemplated in Messrs. Lyon and Co.'s last plan, might be met by keeping the height 5 feet under what these gentlemen calculate, and which would properly be more convenient for trade. To obtain rubble stone for this additional work, the excavation in the harbour might be increased from 80 to 100 feet in width. All these will, no doubt, be useful improvements if the supplies can be furnished. Dunbar would thus have a better secured and larger harbour, and a more convenient roadway for trade along the pier, toward which the town might be disposed to contribute. Indeed the conversation I had with the magistrates leads me to imagine they would be inclined to do so. For the sake of the work and of the contractors, no time should be lost in determining this. To have the work such as that the contractors themselves have

Appendix C.

Dunbar.

No. 39.
Walker's Reports on the new Harbour.

confidence in it is worth something; and as they are responsible for its security until the completion of the works, and do not appear to have discovered until after they had contracted that it would not be strong enough, they may be disposed to reduce the extra sum they had named.

There can, I consider, be no better way to save time than to let Mr. Mitchell know if he may go any and how much farther in point of outlay, and (subject to approval) to let him make such modifications in his plan as the sum at his disposal may allow him to do.

There are few points respecting the work which I consider worthy of remark; they are matters of detail, which I think it is unnecessary to trouble you with, but I propose to name them to Mr. Mitchell for his consideration.

My attention had, previous to my visit, and also when at Dunbar, been drawn to the question of a harbour of refuge, by connecting the detached rocks that lie off the present harbour in front of the town, so as to form a breakwater to the deep water that is within them. A safe harbour of ample depth might thus be formed, but not without considerable expense, and the area for a harbour of refuge would not be large, still it may be the best on the coast, and if so is worthy of serious consideration. This is a matter of comparison, on which, without a more intimate knowledge of this and other competing situations, and without calculations, I cannot pretend to give an opinion, and your instructions to me do not at all refer to this more extensive question.

Sir George Clerk, Bart. I have, &c.,
&c. &c. &c. J. Walker.

No. 40.
Extract from the Acts of Convention of Royal Burghs.

No. 40.

Extract from the Acts of the General Convention of Royal Burghs of Scotland, held at Edinburgh, the 9th of July, 1844.

"The same day, the Commissioner for Dunbar drew the attention of the Convention to the nature of the works presently constructing at Dunbar Harbour, and showed that these, at very small additional expense, could be formed into a harbour of refuge for the coasting trade; and, therefore, moved, that the Convention should adopt such measures as may be considered expedient for securing the attention of Government to a matter of such importance to the coasting trade of the country; and, in the mean time, that they should petition the Lords of Her Majesty's Treasury, and, if necessary, both Houses of Parliament, on the subject; and that the individual burghs be requested to urge the importance thereof on their respective representatives; which motion was unanimously agreed to, and a form of petition approved of and adopted; and the preses authorized to sign the same, and the seal of the Convention to be affixed thereto, and transmitted to James M. Balfour, Esq., M.P., to be laid before the Lords Commissioners of Her Majesty's Treasury, and, if necessary, before Parliament accordingly; and remitted the matter, *quoad ultra*, to the annual Committee, to adopt such other steps as might be thought necessary in this matter. The petition was ordered to be recorded, and printed after the Minutes of this Convention, and transmitted to the several burghs, and to all the members of Parliament for the burghs."

No. 41.
Petition of the Royal Burghs of Scotland.

No. 41.

Unto the Right Honourable the Lords Commissioners of Her Majesty's Treasury,—The Humble Petition of the Royal Burghs of Scotland, in General Convention Assembled.

Shewath,

That your petitioners are deeply interested in the prosperity and safety of the navigation of the country.

That they have frequently to lament the fearful destruction of life and property which yearly takes place from the want of harbours of refuge; and these frightful exhibitions very often happen at the mouth of the Frith of Forth, where vessels frequently lie wind-bound for many days, and are often either driven off the coast or wrecked for want of a safety harbour.

That the Commissioners of the British Herring Fisheries, on the part of the Treasury, and the town of Dunbar, are now in the course of erecting a very convenient and extensive Boat Harbour at Dunbar, near the mouth of the Frith, where many of these wrecks take place: That your petitioners, from their local knowledge and from good information, are of opinion that, by deepening the entrance, or by the erection of a small jettee, either of which might at present be done at no great expense, a safe and convenient harbour of refuge for the coasting trade might be procured, and thus be the means of saving much valuable life and property.

That your petitioners are of opinion that such works are purely of a public nature, and ought to be defrayed at the public expense; and they believe that no grant of public money could be more beneficially bestowed than by thus adding to the security of the navigation of the country, and preventing the fearful losses which occasionally take place.

That the Lords of Her Majesty's Admiralty have already stated their opinion that Dunbar offers great facilities for making a Breakwater Harbour; and, therefore, your petitioners feel called on earnestly to press the subject at present on the officers of Her Majesty's Treasury, while there are other works going on at that harbour.

May it therefore please the Right Honourable the Lords Commissioners of her Majesty's Treasury to take this very important matter into consideration, and adopt such steps as they may see necessary for accomplishing so vast an improvement to the navigation of the country.

And your petitioners shall ever pray, &c.

Signed in name and by appointment of the General Convention of Royal Burghs, and the Seal of Convention affixed hereto at Edinburgh, this 10th day of July, 1844.

(Signed) Ad. Black, *Lord Provost of Edinburgh, and Preses of the General Convention of Royal Burghs.*

DUNBAR.

No. 42.

Memorial of the Harbour Committee.

No. 42.

The Memorial of the Harbour Committee of the Burgh of Dunbar to the Tidal Harbours Commission.

HUMBLY SHEWETH,

That it is the opinion of many naval gentlemen, high in command and most competent to judge, that the natural capabilities of Dunbar are the best on the east coast of Scotland for an extensive harbour of refuge, and that the situation is excellently adapted for the purpose.

There is transmitted herewith a sketch of the proposed harbour. It contains an area of fully 60 acres. The depths at low water are marked on it, as well as the height of the chain of rocks which the harbour is intended to connect. The bottom is generally sandy, shelving outwards, and it is known that no silt has accumulated within the memory of man. There is a sufficient quantity of excellent building stones at low-water mark. Their removal would add to the extent of the harbour; two lime-kilns are within two miles.

On the sketch there is laid down a view of both sides of the Frith of Forth, which shows that the entry to the proposed harbour may be land locked, and thus completely sheltered from all sea storms.

A harbour of refuge at Dunbar would be of immense benefit to the fisheries, which are prosecuted to a very great extent at the mouth of the Frith of Forth, and where, frequently, melancholy losses take place for want of a refuge port.

Such a harbour would also be of infinite advantage to the merchant service. The yearly loss of life and of property on the coast is very great. The Memorialists have not the means of stating the amount within the range to which such a harbour would give shelter, as it would be of great benefit to all vessels from the Humber to the far north of Scotland; but they have the means of knowing that, between the years 1810 and 1822, there were of *total* wrecks in the immediate vicinity of Dunbar 27 vessels, valued with their cargo at 108.494*l.* And they also know that, for the last 20 years, the average wrecks in the same neighbourhood is at least 8¼ a-year.

But by far the greatest advantage the country would derive from such a harbour would be in the case of a war.

From the introduction of war steamers, the Memorialists are humbly of opinion, that either a steamer or sailing vessel being as heretofore stationed at Leith, would afford no protection to the east coast of Scotland, or even to the Frith of Forth. Before intelligence could be sent there, and a vessel dispatched down the Frith about 30 miles, and probably with a contrary wind, an effectual landing might be made, or a whole town laid in ashes; whereas, with a chain of signals beginning, say at St. Abb's Head, on the south, to Dunbar, and from Dunbar by the May, Bell Rock, &c, the whole east coast of Scotland might be effectually secured by one or two armed steamers being kept at Dunbar.

May it therefore please your Honours to consider the premises, cause a survey to be made, and thereafter do as may seem advisable.

And your petitioners will ever pray.

June 1, 1845.

C. MIDDLEMASS, *Provost and Convener.*

APPENDIX C.

DUNBAR.

No. 43.
Wrecks in the vicinity of Dunbar.

No. 43.

LIST OF WRECKS ENTERED IN THE BOOKS OF LLOYD'S AGENTS AND TH

It is estimated that during the period there were at least as many more wrecks in that

Date.	Name.	Tons.	Rig.	Cargo.	Belonging to	From
1816.						
Nov. 19	John and Agnes	..	Sloop	General	Leith	Newcastle
1817.						
January 3	Albion	..	Brig	Wheat	Dunbar	Bamburgh
February 6	Two Sisters	..	Sloop	Grain	Alnmouth	Alnmouth
1819.						
February 21	Commerce	..	Ditto	Barley	Arbroath	Newcastle
,, 16	Friendship	..	Ditto	Wheat, &c.	Dunbar	Dunbar
October 12	Nancy	100	Ditto	Coals	Kincardine	Newcastle
November 10	Fortune	..	Brigantine	Hemp, &c.	Arbroath	St. Petersburg
1820.						
May 8	Hazard	..	Galliot	Timber	..	Memel
November 21	Henry	..	Brig	Barley	Yarmouth	Yarmouth
March 24	Adventure	..	Schooner	Wheat	Ditto	Newcastle
September 5	Providence	..	Lugger	Bottles	Sunderland	Sunderland
November 4	Lady Ann Murray	..	Sloop	Slates	Gatehouse	..
,, 25	Nancy	90	Brig	Pavement	Arbroath	Arbroath
1823.						
February 3	Mary	..	Ditto	Coals	Whitby	North Shields
1824.						
March 8	Eleanor	..	Ditto	Darley	Lynn	Lynn
November 2	Albion	57	Sloop	Grain	Leith	Berwick
,, 2	Friendship	..	Ditto	Ditto	Dunbar	Ditto
1825.						
March 7	Charles XIV.	..	Brig	Timber, &c.	Gottenberg	Gottenberg
August 15	Hope	..	Fishing craft	Fish	Dunbar	Dunbar
October 27	Fancy	..	Brig	Timber	Aberdeen	Pictou
November 18	John and Margaret	..	Sloop	Barley	Berwick	Berwick
,, 28	Industry	70	Ditto	Coals	Burntisland	Sunderland
1826.						
April 10	Meanwell	32	Ditto	Whiting	North Shields	Shields
July 22	Alexander	67	Ditto	Lime	Limekilns	Sunderland
September 15	Sam	41	Ditto	Grain	Berwick	Berwick
1827.						
February 26	James and Mary	49	Ditto	Coals, &c.	North Shields	Newcastle
March 4	Eliza	93	Schooner	Ditto	Portsoy	Sunderland
,, 4	Brothers	..	Sloop	Grain	Peterhead	..
,, 4	Sarah	..	..	Barley	Lynn	..
,, 5	Zealous	55	Sloop	Ballast	Eyemouth	Dunbar
,, 5	Mary	244	Brig	General	London	London
,, 8	Janet	55	Sloop	Coals	Gardenstone	Sunderland
April 5	Leith	128	Schooner	General	Leith	Hull
,, 25	Peggy	..	Sloop	Ballast	St. Andrews	Dunbar
September 10	Edina	..	Schooner	General	Leith	Hamburg
1828.						
January 31	Five Brothers	..	Sloop	Whiting	Anstruther	Shields
May 31	Nelly	..	Ditto	..	Pittenweem	..
August 2	Fanny	148	Brig	..	Dunbar	Dysart
September 10	Friends	56	Sloop	Wheat	Dundee	Leith
1830.						
March 29	Fife Packet	95	Smack	General	Ditto	Dundee
July 2	Liberty	..	Schooner	Ditto	Wells	Rotterdam
August 28	Peggy	50	Sloop	Coals, &c.	Aberdeen	Newcastle
,, 28	Caroline	..	Schooner	..	Kincardine	..
November 23	Thomas	..	Brig	Ballast	Dundee	Dundee
December 17	Britannia	51	Sloop	Barley	Montrose	Berwick
1831.						
February 12	Sally	..	Brig	Timber	Arundel	..
July 15	Mary M'Gill	..	Sloop	Coals	Rothesay	Sunderland
December 23	Hannah	..	Brig	General	Dundee	Riga
1832.						
January 16	Thane of Fife	..	Sloop	Oats	..	..
February 11	Ann and Katherine	..	Ditto	..	Newcastle	..
1833.						
March 11	Barbara and Ann	..	Schooner	Pig-iron	Ditto	Glasgow
1834.						
June 2	George of Banff	58	Sloop	Coals	Banff	Sunderland
1835.						
January 20	William Davidson	..	Schooner	Ditto	Thurso	Newcastle
,, 20	Dispatch	..	Sloop	Barley	Arbroath	Arbroath
November 6	Barbara	90	Schooner	Iron	Alloa	Newport
1836.						
April 3	Speculant	84	Galliot	Coals	Drano	Leven
July 29	Katherine	70	Schooner	Ballast	Newcastle	Dundee
September 30	Ariel	..	Sloop	Wheat	Boston	Boston
October 13	Ann	..	Ditto	Coals	Sunderland	Aberdour
1837.						
October 1	Treat	..	Schooner	General	Leith	Leith
November 30	Albion	84	Ditto	Wheat	Boston	Boston
1838.						
February 7	Dispatch	54	Sloop	..	Dunbar	..
April 9	Sarah	..	Ditto	..	Sunderland	Banff
June 18	Margareth	..	Galliot	Coals	Crantz	Alloa

TOWN CLERKS AT DUNBAR, AS HAPPENING IN THAT NEIGHBOURHOOD.

ourhood belonging to parties insured in other Offices, and of which no record is preserved.

APPENDIX C.

DUNBAR.

No. 43.
Wrecks in the vicinity of Dunbar.

Bound to.	Wind.	Weather.	Exact spot where wrecked.	Lives lost.	Remarks.
Leith	..	..	Tyne-sands, one mile west	..	. . .
London	..	..	Put into Dunbar	..	Distress.
Grangemouth	..	..	Put in	..	Ditto.
Montrose	..	..	Stranded on Tyne-sands	..	Cargo saved, and vessel repaired, and proceeded on her voyage.
..	S.E. to N.E.	Blowing hard	Skateraw, four miles east	..	Vessel lightened and brought back to Dunbar.
Leith	N.E.	Gale	On rock opposite Tyne Water-foot	..	Vessel went to pieces.
Ditto	N.E.	Gale	On rocks at back of battery	..	Ditto.
Dunbar	..	..	On rocks near Dunbar Bay	..	Got into harbour.
Leith	S.S.W.	Squall	Four miles east of Dunbar	1	Vessel went down.
Ditto	S.E.	..	Ditto	..	Struck on a rock, filled with water, and sunk.
Ditto	..	Stress of weather	Struck on rocks off harbour	..	Sunk, but got up again.
Newcastle	N.E.	Stormy	Four miles east of Dunbar	1	Sprung a leak, and the crew ran her ashore.
Leith	..	..	Three miles west of Dunbar	..	Struck on a rock and sunk
..	..	..	Four miles west of Dunbar	..	Stranded on Schougall rocks in a snow-storm
Dunbar	..	Strong wind	Close to west of harbour	..	In attempting to make harbour-mouth fell to leeward and went on rocks, a total wreck.
Grangemouth	North	Ditto	Ditto	..	In a strong gale from westward came to anchor in the roadstead; the wind suddenly changed into north, and went ashore.
Ditto	North	Ditto	Ditto	..	
Ditto	E.S.E.	Severe gale	Four miles east	..	Struck on rocks, cargo saved, vessel total wreck.
Dunbar	..	..	Off Goswick	..	Run down, crew got on board other vessel.
Ditto	..	..	Struck on harbour rocks	..	Vessel got into harbour much damaged.
Grangemouth	..	Severe gale	Four miles west of Dunbar	..	Stranded; vessel and cargo saved, though much damaged.
Leith	..	Severe weather	Off Eyemouth	..	Cut from anchors; got into Dunbar.
Ditto	..	Stress of weather	Eastbarns, three miles east	..	Cast on rocks.
Inverness	..	Fine	Catcraig	..	Vessel run ashore.
Grangemouth	..	..	Two miles off Dunbar	..	Sprung a leak and sunk.
Perth	S.S.W.	Heavy gale	Eastbarns	..	Cast on shore.
Portsoy	..	..	Five miles east of Dunbar	..	. . .
Leith	..	Stress of weather	One mile west	4	Stranded on Tyne-sands and went ashore.
..	..	Severe storm	Off St. Abb's Head	5	Vessel and cargo total wreck.
Berwick	E. by S.	Stress of weather	Near Dunbar	..	Vessel drove ashore.
Inverkeithing	..	Same gale	Thornton Loch, five miles east	..	Vessel discharged and got off.
Banff	..	Gale	Peffer-sands, four miles west	..	Drove ashore.
Leith	..	..	Skateraw, five miles east	..	Stranded, but got off.
..	..	..	Rocks off harbour	..	Got into Dunbar.
Leith	..	..	Three miles east	..	Stranded, but got into Dunbar.
Glasgow	..	..	Eastbarns, three miles east	..	Went to pieces on rocks.
..	..	..	Five miles west	..	Stranded on Schoughall rocks, but got off.
Copenhagen	..	..	Off Dunbar	..	Struck on rocks, waiting for orders.
London	..	Squally	Fidra, six miles west	..	Got into Dunbar.
Hull	W.S.W.	..	Redheugh, ten miles east	..	Went on shore.
Leith	..	Thick	Goat-reef, three miles east	..	Stranded and wrecked.
Peterhead	..	Heavy gale	Two miles west	..	Run ashore on Tyne-sands.
..	..	..	Eight miles east	..	Ditto ditto.
Newcastle	..	Heavy gale	Three miles east	..	Struck on rocks below Eastbarns.
Grangemouth	..	..	Four miles east	..	Stranded off Skateraw; afterwards got off.
..	..	..	Near North Berwick	..	Struck on Carr-rock.
Wick	..	..	Five miles east	..	Drove on shore off Thornton Loch.
Hull	..	..	Six miles west of Dunbar	..	Stranded on Schoughall rocks.
..	..	..	Near North Berwick	..	. . .
..	..	..	. . .	..	. . .
Colchester	..	..	Rocks near mouth of harbour	..	Vessel ultimately got off.
Peterhead	..	..	Ten miles east	..	Vessel went down some time after springing a leak.
Thurso	..	..	Six miles east of Dunbar	..	Went down.
Hull	..	..	One mile east	..	Went ashore; got off and brought to Dunbar.
Alloa	..	..	Two miles east	..	Went to pieces on reef at Eastbarns.
Drano	..	..	Seven miles west	..	Broke anchors, and otherwise much damaged.
Newcastle	..	..	Five miles east	..	Went on shore at Thornton Loch.
Leith	..	..	One mile west	..	Stranded on Tyne-sands, abandoned, and afterwards brought to Dunbar.
Dover	..	..	Four miles west	..	Went to pieces on rocks below Tyninghame.
Hull	..	..	Seven miles west	..	Stranded on Schoughall rocks; got off, and sent to Leith.
Leith	..	..	Three miles east	..	Stranded below Eastbarns; got off; taken to Dunbar.
..	..	..	Ten miles west	..	Cast ashore on North Berwick beach.
Sunderland	..	..	Near harbour	..	Got into harbour with great exertion.
Hamburgh	..	..	One mile east	..	Struck on rocks near Broxburn Water foot; got into Dunbar.

DUNBAR.

No. 43.
Wrecks in the vicinity of Dunbar.

LIST OF WRECKS ENTERED IN THE BOOKS OF LLOYD'S AGENTS AND THE

Date.	Name.	Tons.	Rig.	Cargo.	Belonging to	From.
1839.						
January 19	Hannah and Success	..	Sloop	Barley	Newcastle	Eyemouth
March 1	Robert and Margaret	..	Ditto	Ditto	Alemouth	Alemouth
November 30	Dorothea	..	Ditto	Ballast	Copenhagen	Faro
December 2	Hero	..	Schooner	Grain	Yarmouth	..
1841.						
April 21	Liberty	..	Sloop	Grain	Dunbar	Eyemouth
1842.						
March 18	Robert	125	Brig	Ditto	Arbroath	Stetin
April 11	Abvias	..	Sloop	Whiting	Newcastle	Newcastle
,, 11	Dorothy	..	Ditto	Grain	Lynn	Lynn
May 21	Dispatch	..	Ditto	Bone-dust	North Berwick	Fisherow
September 1	Don Cossack	..	Schooner	Herrings	Leith	Holy Island
November 24	Brothers	..	Ditto	Pig-iron	Port Gordon	Grangemouth
December 17	Anna Catherina	..	Galliot	Coals	Peterson	Clackmanoon
1843.						
January 13	Cleveland	..	Schooner	Bark	Newcastle	Antwerp
,, 13	Isabella Black	34	Sloop	General	Kirkaldy	Newcastle
October 12	Mary	90	Schooner	Ballast	Crail	Dort
,, 18	Mary	27	Sloop	Machinery	Dunbar	Dunbar
,, 28	Branch	86	Schooner	General	Kirkaldy	Bargona
,, 28	Maria	..	Ditto	Ballast	Aberdeen	Aberdeen
,, 28	Pomona	..	Brig	Ditto	Ditto	Rotterdam
December	Emmanuel	..	Galliot	Coals	Hamburgh	St. David's
1844.						
March	Mag Miller	..	Schooner	Wheat	Dunbar	Dunbar
1845.						
February 15	Haabet	83	Sloop	Coals	Copenhagen	St David's
March 11	Mary	..	Ditto	Ditto	Dunbar	Alloa
July	Catherine	..	Ditto	Ditto	Newburgh	Hartlepool
August 20	Red Rover	..	Fishing-boat	Fish	Buckhaven	Buckhaven
,, 20	Customs	..	Boat		Dunbar	Dunbar
September 11	Tees	..	Steamer	Ballast	Stockton	Stockton
1846.						
February	Mary	..	Sloop	Oats	Stonehaven	Stonehaven
	Ebenezer	..	Schooner	Iron	Braxum	Newport
June 30	Caroline	38	Sloop	Pig-iron	Yarmouth	Port Dundas
August 12	Alexandria	..	Lugger	Fish	Gravelines	Burgoni
1847.						
February	Eliza Burns	..	Sloop	Coals	Dunbar	Frith

Making a total of 93 vessels, in 30 years, wrecked or disabled in the vicinity, to the greate

TOWN CLERKS AT DUNBAR, AS HAPPENING IN THAT NEIGHBOURHOOD—*continued.*

APPENDIX C.

DUNBAR.

No. 43.
Wrecks in the vicinity of Dunbar.

Bound to.	Wind.	Weather.	Exact spot where wrecked.	Lives lost.	Remarks.
Glasgow	..	..	Four miles east	..	Total wreck below Skateraw.
Leith	..	..	Three miles east	..	Total wreck below Eastbarns.
Newcastle	..	..	Four miles west	..	Wrecked.
Ditto	..	..	Ditto	..	Total wreck; cargo all lost.
Glasgow	..	..	One mile east	..	A wreck.
Leith	..	..	Four miles west	..	Vessel on rocks; total wreck.
Ayr	..	..	Near Dunbar	..	Vessel struck and sunk.
Leith	..	Foggy	Bass Island	..	Got into North Berwick.
Skateraw	East	..	Five miles west	..	Struck with heavy sea; got into Skateraw with difficulty.
Leith	..	..	Two miles east	..	Stranded, but got off
Sunderland	..	..	Ten miles east	..	Vessel went down
Altona	S.W.	..	Three miles east	..	Cargo saved; vessel total wreck.
Arbroath	..	..	Four miles east	..	Got on shore; brought to Dunbar.
Kirkaldy	..	..	Ditto	..	Vessel total loss; part of cargo saved.
Grangemouth	..	..	Two miles west	..	Stranded.
North Berwick	North	..	Rocks off harbour	..	Wind suddenly shifted, laid vessel on rocks; got off.
Leith	..	..	Three miles east	..	Stranded; got off; brought to Dunbar.
Newcastle	..	..	Six miles east	..	Total loss.
Grangemouth	..	..	Four miles west	..	Stranded, but got into Dunbar.
Hamburg	..	..	Near North Berwick	..	Cargo lost; vessel saved.
Glasgow	..	..	Ditto	..	Vessel wrecked; cargo saved.
Copenhagen	..	..	Three miles west	..	Dismantled at sea; got into Skateraw.
Catcraig	..	..	Three miles east	..	Driven on shore.
Newburgh	..	..	Two miles east	..	Went on shore; cargo and vessel saved.
Dunbar	..	Heavy sea	Near Dunbar	4	Total wreck.
Ditto	..	Ditto	Ditto	6	Ditto, went out to save the preceding.
Londonderry	..	..	Ten miles east	..	Leak; vessel went down.
Leith	..	..	Eight miles west	..	Struck; abandoned by crew; got into North Berwick.
Grangemouth	..	Thick	Five miles east	..	Vessel total wreck; cargo saved.
Hull	..	..	Ten miles east	..	Dismantled; got into North Berwick with assistance.
Frith	..	..	Four miles east	..	Struck on rocks and went down.
Skateraw	..	Squally	Six miles east	5	Vessel lay off, but could not take the harbour.

part of which a harbour of refuge at Dunbar would have afforded shelter.

W. and J. RITCHIE, *Town Clerks.*

EYEMOUTH.

No. 44.
Evidence taken
13th April, 1847.

No. 44.

Examining Commissioner—Captain WASHINGTON, R.N., F.R.S.

Present:—Mr. FERME, Mr. INNES, Mr. BOWHILL, Mr. STURDY of Flemington, Harbour Trustees; Lieut. DALYELL, R.N., Officer of the Coast Guard; Mr. ALLAN; Mr. GILLIE, Collector; Mr. DICKSON; Mr. HUTTON; Mr. WHILLIS, Harbour-master; Mr. ROBERT CALDER, Harbour-clerk; Messrs. N. HUDSON, G. HAY, Master Mariners; ROBERT CRAIG, Pilot; and many sailors and fishermen.

[*The Admiralty Chart of Eyemouth, made in* 1839, *by Mr. E. K. Calver, R.N., under the direction of Captain Slater, R.N., on the scale of* 30 *inches to a nautic mile, was laid on the table.*]

The COMMISSIONER having read the Royal Commission, stated that this was an inquiry into the past and present state of the harbour of Eyemouth, and as to its capability for future improvement; that the meeting was public; and that he invited the remarks and suggestions of pilots, sailors, fishermen, and others interested in the welfare of the port. He said that he had at low water that morning, in company with the Harbour-master, visited and inspected the quays, piers, and the works of the new jetty, and he now wished to hear in addition the remarks and opinions of those best acquainted with the place.

Mr. ROBERT CALDER—Has been clerk to the Harbour Trust since 1846; the Act of Parliament under which the trustees now act is the 2 Vict. c. 36, which repealed the 37 Geo. III., c. 49. Prior to 1797 there was no separate trust; twenty-five trustees were named in the Act, some of whom are no longer living, others have left the county, and the number is now reduced to eleven; quarterly meetings are held, three trustees form a quorum, and at times a difficulty is found in collecting even that number; the clauses of the Act have generally been complied with; the pilotage dues are painted on a board on the quays; the shore dues are not so at present; there are no bye-laws, except as to pilotage regulations, and reducing the charges or duties on some of the goods mentioned in the schedule appended to the Harbour Act. No complaints respecting ballast, or from other causes, have been laid before the Board. Witness writes the minutes, which are generally signed by the Præses at the meeting, before leaving the chair.

Mr. THOMAS BOWHILL—Has been Treasurer to the Trust since 1834. Produces account books for that period. The revenue, in 1834, was 94*l.* 17*s.* 5*d.*; in 1846, 281*l.* 17*s.* 10*d.* A debt of 2000*l.* at 4 per cent. interest, shortly to be raised to 5 per cent., was caused, in 1843 and following years, by removing the old and building a new jetty, in order to form a sheltered basin for vessels to be clear of the freshets; 522*l.* of this sum was expended in deepening the harbour, which was much needed. All the works were done by contract, and great benefit has arisen from them. The salaries of the clerk and harbour-master are only 8*l.* each. The accounts are audited annually by the chairman of the meeting, and entered on the minutes. The treasurer and collector both give security, one in 50*l.* the other in 20*l.* None of the meetings of the Trust are public. The Act of 1839 was procured in order to enable them to increase the dues: the expense of this Act, obtained solely for the public benefit, was 460*l.* 19*s.* 9*d.*, or nearly two years' revenue. From a long residence, is of opinion that Eyemouth is an important fishing station, as well as a refuge harbour, in a limited sense, for wind-bound vessels. Out of 340 arrivals during the past year many sought shelter on account of the wind; various memorials have been presented to Government, and surveys made relative to enclosing the bay by a breakwater, and thus making it an asylum harbour, accessible at all times: the peculiar positions of the Hurcar, Hincar, and Luffhard rocks, adapt them admirably for such a purpose. The cost is estimated only at 50,000*l.*; and the numerous wrecks that have taken place in the immediate vicinity would alone fully warrant such an outlay. The position of Eyemouth, also, as the nearest harbour to St. Abb's Head, the turning point of this part of the coast, points it out as the proper site for such an erection. The late Admiral Sir David Milne expressed a strong opinion in favour of such a harbour; Captain Sir Samuel Brown also is favourable to it, and himself laid down moorings in the bay for steam vessels. The North British Railway now passes within 2½ miles of the harbour, and thus affords speedy communication with every part of the country; and lastly, from the Humber to the Firth of Forth, a distance of about 200 miles, there is no harbour of refuge, accessible at all times, along the whole coast.

Mr. FERME—Chairman of the Harbour Trust, fully concurs in all stated by the treasurer as to the necessity of a low-water harbour in this neighbourhood. Recollects, in 1828, in a north-easterly gale, seven vessels wrecked within four miles of Eyemouth; two of these were at Burnmouth, at two miles to the southward, and two at Killiedraughts, to the northward; several lives were lost on that occasion: out of one crew of five two only were saved. For the numerous herring-boats, too, which frequent this harbour in the fishing season, such accommodation would be invaluable, and the means of saving many a life.

Mr. J. F. GILLIE—Has been collector of dues at this port for the last 3½ years, during which time the revenue has materially increased. A large portion of the dues arises from wind-bound vessels that take shelter here. The dues are not so high as at Berwick and some of the neighbouring ports. The chief exports are grain, herrings, &c., and the imports coal, timber, salt, &c.; nine timber vessels arrived the last year. In 1845 there was a great increase in the revenue, which amounted to 498*l.* 5*s.* 1*d.*; this was in consequence of the materials brought for the construction of the North British Railway. The arrivals in 1846 were 30 foreign vessels of 2047 tons, and 275 coasters of 11,020 tons. The population of the place is about 1400, of which 110 are fishermen.

The COMMISSIONER, having examined the harbour books, said, as far as a cursory inspection would enable him to judge, the minute-book, treasurer's account-book, and collector's book of dues, were carefully kept, and appeared to be in good order.

Lieut. J. DALYELL, R.N.—Has been eighteen months on the coast, in charge of the Coast Guard station at Burnmouth, and was formerly two years in the "Cherokee," cruizing on this part of the coast. Concurs in what has been said respecting the want of a low-water harbour. In an easterly gale there is no place to run for nearer than the Humber to the southward, and the Firth of Forth to the northward; but to gain the latter it is necessary to weather St. Abb's Head, which cannot always be done. In 1813, the "Cherokee" was caught in a gale, and embayed between St. Abb's Head and Fast Castle Head, where she was obliged to anchor and cut away her masts, and happily rode it out;

EYEMOUTH.

No. 44.
Evidence taken
13th April, 1847.

whereas had there been a harbour of refuge she could have made for it. In the whole extent of 200 miles of coast there is no place at which a war-steamer cruizing off could get a supply of coal at low-water time.

Mr. Jas. Whillis—Has been 11 years harbour-master, and acquainted with Eyemouth all his life; is not a sailor. The old pier was rebuilt about 50 years since; the new south pier was designed by Smeaton, and built in 1760 by Cramond, of Dunbar; both piers are built of plum-pudding stone, or conglomerate from the Fort Point; the stones, of about two cubic feet each, are laid dry in courses; the foundation is on rocky skares of whinstone; the stones in the face of the old pier are giving way in several places; it is to be repaired and pointed during the next summer. In 1843, an old quay wall or jetty was pulled down, and a new wall, enclosing a sort of upper basin, was built, at an expense of 2,200*l.*, including deepening the river about 20 inches. This basin is found to be very useful in sheltering vessels from the freshes. The range of the swell at high water, in heavy north-easterly gales, is sometimes very great; but no damage to vessels has arisen; the shore dries out about 70 yards beyond the pier heads at low-water spring tides. The average rise of spring tides is 14 feet, and of equinoctial springs 16 feet; neaps rise to 10 feet; the stream of tide flows about 200 yards above the bridge; there is no breaking place in the harbour for a vessel to run upon in case of need; nor is there any crane on the quays—one to lift stone would be a great accommodation. There was a pier-head light shown during the fishing season, but witness believes it was discontinued two years since, because the fishermen refused to pay towards keeping it up.

Commissioner.—It is extremely to be regretted that any cause should have led to its discontinuance, and the fishermen should not object to pay a small rate to keep up the light. The want of a light might cause the destruction of a boat's crew, and a heavy responsibility would rest upon the trustees should such a circumstance take place. As gas is already led down to the quays, an expense of 5*l.* would suffice to place an extra burner, and I trust that no time will be lost in carrying this recommendation into effect. I strongly urge it upon the serious consideration of the trustees.

Witness.—As many as 14 large fishing boats, carrying from 6 to 7 men each, and 40 herring boats, employing 5 men and a boy each, fish from Eyemouth during the season; occasionally, also, has seen 26 French fishing vessels in the harbour, and 40 coasters, at one time. A deposit of about a foot a year takes place in the basin; and on building the new wall, or jetty, a sluice was formed, in order to have the power of sluicing away this deposit; but the sluice got out of order, and has been closed up. In high tides and freshes the water rises level with the surface of the quay, and on one occasion it rose 2½ feet above. The river wall along the ballast quay is much out of repair, in fact it has fallen into the river in many places. The ballast supplied to shipping is charged 7*d.* a ton; has heard no complaint against it; admits that at times it is no better than rubbish from the streets; thinks it would be a double benefit if the ballast were gravel taken from the bed of the river. Deepening the harbour generally is one of the improvements most wanted, but it would be attended with great difficulty, as rocky skares of whinstone cross it in many places. Is of opinion also that shelter is much wanted in the bay: this is the great improvement required, and one easily accomplished if there were but funds. Remembers the wreck of the "Perseverance," of Banff, off the Fort point, when all were lost but one: five vessels were wrecked in 1822; the "Endeavour," of Shields, in 1820, was lost in Eyemouth Bay. Neither the rock called the Inner Buss, which has only 7 feet water over it, nor the Buss off Luff-hard, has a beacon on it; the former might easily be blasted away.

Mr. Robert Craig—Has been a pilot for 25 years, and for 45 years acquainted with the harbour of Eyemouth. There are 20 pilots; they do not pass any examination, but receive a licence from the trustees on producing certificates of good character; thinks that the new jetty is a great improvement; the harbour has been deepened about a foot—but deepening is the thing most required; and sees no reason, except the want of funds, why the river should not be deepened more. The harbour is safe when once inside; there is 14 feet depth of water over the bar at spring tides, and 10 feet at neaps; the bar is of sand and shingle over rock; it varies in height as much as 1 or 2 feet. N.E. winds are the worst, and send in a heavy swell, but once round the corner of the quay, vessels are safe. At the pier head, a rocky skare which crosses the bed of the river dams up the water; this has been lowered about 20 inches, but knows no reason why it should not be lowered more, and thinks that this would be the greatest improvement that could be made for the present. The skares higher up also should be removed; if they could not be dredged, they might easily be blasted away; if greater depth of water were obtained larger vessels could come to the harbour, and it would be a great boon both to coasters and fishing boats. Ballast is charged 7*d.* a ton, and occasionally old rubbish is put on board as ballast; if it gets wet it might choke the pumps; the ballasting is let by contract. There is a dangerous rock in the bay, called the Inner Buss, with only six feet water on it at low tide; it ought to be blasted away; neither it nor the Luff-hard Buss has any beacon on it. Agrees in all said to-day as to the want of a harbour of refuge somewhere on this coast.

Mr. Nathaniel Hudson—Commands the "Jane and Mary," of Newcastle; has been at sea since 1812, and 19 years in the coasting trade; during his experience the chief wrecks which have taken place in Holy Island Road, with northerly winds, would have been spared had there been a harbour of refuge in Eyemouth Bay, and great loss of life would have been avoided. On one occasion he left the Tay in a sloop; got damaged in striving for Holy Island Road, and at last got within the bar at Waren; had there been water at Eyemouth would certainly have come here. Is of opinion that leading lights are wanting as a guide into the harbour; one light should be a fixed light, the other a tidal light, to be shown as soon as there are 10 feet over the bar; would not object to pay dues for such lights, nor does he think any other coaster would. Thinks there should be a warping buoy off the harbour's mouth; there was one formerly, but it broke away; the sinker and chain yet remain. and nothing is wanting but the buoy to be attached; is of opinion that if the chain breaks a stouter one should be used; buoys are moored all along the coast in the North Sea, and knows no reason why one should not be made to hold in Eyemouth Bay. Has derived benefit from the improvements in the harbour, but more deepening is wanted; if the harbour were deepened, so as to leave a depth of 12 feet over the bar at neap tides, witness believes that many vessels would come here that now run to Holy Island, as, in a northerly gale and lee tide, that is a difficult place to take.

Mr. George Hay—Is master of a coasting vessel from Perth; agrees in all that has been stated by the last witness as to the want of lights, of a warping buoy, and especially as to deepening the harbour. Feels satisfied that if the harbour were deepened so as to ensure 12 feet over the bar at high water of neap tides, many a vessel would seek shelter here that now goes to the southward. Vessels are commonly driven from Coldingham Bay, past Eyemouth, to the southward; and this would not occur if there were a moderately deep-water harbour at this spot.

No. 45.

No. 45. Return to Order of the House of Commons of the 9th August, 1844.

Return to Order of the House of Commons of the 9th August, 1844, *relative to Eyemouth Harbour*

SIR,

Eyemouth, February 15, 1845.

I DULY received the favour of your letter of the 1st instant, requesting copies of all maps and reports by engineers, relative to Eyemouth Harbour.

I now beg to send herewith the following documents, namely—

1. Act of Parliament for repairing Eyemouth harbour, 1797.
2. Ditto ditto, 1839.
3. Copy plan, by Joseph Mitchell, civil engineer.
4. Copy plan, by Balfour Balsillie, mason.
5. Memorial, by the Shipmasters frequenting the port, November 8th, 1836.
6. Printed statement of the capabilities of Eyemouth bay and harbour, for an Asylum Harbour, containing copy of Mr. Jardine and Mr Mitchell's Reports, &c.

I may mention that the improvements recommended by Mr. Jardine, and Mr. Mitchell were not executed, the trustees of the harbour not having sufficient funds.

The improvement recommended by Mr. Balsillie, namely, the enlarging of the mid wall or jetty in the harbour, was executed, and cost upwards of 2,000*l*., for payment of which the trustees borrowed money on security of the harbour dues; but the harbour and bay are still capable of great improvements, although the expense prevents the trustees from undertaking them.

I have, &c.,

To the Hon. Manners Sutton.

THOMAS BOWHILL, *Treasurer.*

No. 46.

Report of JOHN SMEATON, Esq., *C.E, F.R.S., on Eyemouth Harbour.*

No 46. Smeaton, on improving the Harbour.

Austhorpe, May 2, 1767.

THE harbour of Eyemouth lies at the corner of a bay, at which ships can work in and out at all times of tide, or lie at an anchor secure from all winds except the northerly or north easterly. From this circumstance, its situation seems very advantageous; but as the mouth of the river or harbour lies open to the northerly winds, ships cannot lie in safety therein without going up beyond the elbow of the present quay, where the water being shallower by several feet, and the breadth much contracted, the harbour is not only defective in point of capacity but in safety also; for at a full sea, the mouth being wide, the sea tumbles in with so much impetuosity, that great seas find their way round the elbow and make the vessels even there lie not so quiet as is to be wished. In order, therefore, not only to enlarge the harbour, but very greatly to increase the safety of vessels lying therein, it is proposed to build a north pier to defend the harbour's mouth, and to this end nature has furnished a ledge of rocks, not only capable of making the most excellent of all foundations for such a pier, but in as advantageous a situation as could be wished, upon which a pier is proposed to be built according to the plans accompanying this report: for, according to the directions therein specified, the harbour will be defended from all such seas as annoy the bay, and the only point from whence the harbour could be affected by seas coming in through the mouth, are land-locked by the points of the bay, so that the harbour will in its whole extent be perfectly safe in all winds.

It is also to be noted that the same circumstances that concur to make the harbour safe in all winds, afford the vessels means of getting in and out at all winds; and this proceeds from the entry into the harbour lying nearly at a right angle with the direction into and out of the bay. It is also a great advantage that there is a good flow of tide, which, at spring tides, is said to be 20 feet, and there is at the lowest ebb several feet of water at low water between the proposed pier heads: so that there will be less seldom at neap tides than 16 or 17 feet of water in the harbour, which is capable of receiving vessels from 300 to 400 tons, according as they are more flat or more sharp built, and which afterwards can, upon a greater flow of tide, be got into a more advantageous berth.

Another advantage to the executing of the proposed design, arises from a great quantity of rough rocks that lie at the north-westerly point of the bay, very proper for building the outsides of the body of the pier, the inside of which may be done with rough stones, won or blasted from the neighbouring rocks to that upon which the pier is proposed to be built. By this means the pier may be executed at a trifle of expense in proportion to the extent and utility of the design; for the rocks that are represented within the intended pier will be removed and made smooth, so as to procure an addition of harbour room at little or no charge, as they will be used within the pier. When this is done there will be an addition of harbour room in the space between the elbow beforementioned and the pier heads, capable of holding thirty ships of middle size with sufficient passage, and which in time of war will be very useful on this coast, not only for the refuge of coasters from the enemy, but in bad weather for privateers and the smaller-sized vessels acting offensively.

What relates to the method of the work itself will be sufficiently explained by the plans and estimates. I have only to remark that I do not mean to fix the place of the pier with such precision as not to be subject to be somewhat varied.

If it is found convenient, on account of fixing the base, to be a little more in, or a little more out, or the head to be somewhat nearer or farther from the present head, than specified in the plan, I expect the surveyor to use his judgment therein. Also, I do not mean that the ground course of the stones forming the base of the pier should be exactly in a right line, or the bases cut to the same level, or answerable to any given delineation lengthways of the pier, all I desire is, that a bed be cut for each stone declining towards the middle of the pier; as shown in the plan; but they may be upon different levels, and a little more in or out, as best suits to get a firm footing for each particular stone, which stones must be suited in their size and thickness accordingly.

In regard to the repairs of the present pier and quay, where it is necessary to begin at the bottom, I advise to drive a row of piles, six inches in thickness and close together, edge and edge, and the heads being connected by a string piece, to let the ground course of stones be notched upon them as was done at Coldstream bridge. The rest of the quay will be defended by laying a tier of rough stones, sloped up against it at the foot, but not so as to be in the bilgeway of the ship. This would be still more effectually done by driving a row of piles either close together, or at most but nine inches distant from one another, and at about a yard distant from the foot of the pier, so as not to be in the way of the vessels, and to lay a slope of rubble-stones against the foot of the pier between the pile-beads and the wall, as before described, observing always to slope the rubble down stream.

No. 46.
Smeaton, on improving the Harbour.

This, I think, the best way of securing the present quay; but as it will be altogether defended from seaward by the proposed pier, and as the last proposed defence must be attended with some expense and trouble, being only done at short intervals of the tide, I advise to cut the matter of repair short by laying stones only, and take a trial of this till the north pier is built.

J. SMEATON.

No. 47.

Statement of 30 *Shipmasters, &c., relative to Eyemouth.*

Eyemouth, November 8, 1836.

No. 47.
Statement of 30 Shipmasters, &c. relative to Eyemouth.

WE, the undersigned shipmasters and owners of vessels now lying in this port, do certify that it is our opinion that this harbour, in its present state, in the event of north or north-east gales setting in, would prove very insecure for the safety of vessels, and serious consequences would unavoidably result to the shipping, as well as valuable cargoes, particularly to such as are presently wind-bound in this port from foreign ports. This harbour being situated so near to the dangerous headland of St. Abb, renders it the most eligible place of safety to which vessels bound for the North can run, provided the harbour were so improved, that all vessels coming in could lie without risk; and it is further our opinion that this harbour could be so improved, at a comparatively trifling expense, as to render it a complete and safe harbour in all kinds of weather. We would therefore earnestly recommend to the attention, not only of the Commissioners of this harbour, but also the Government, and the shipping interest generally, what we have now suggested on this subject.

JOSEPH PATTISON, "*Britannia of Berwick,*" *and* 29 *other Signatures.*

No. 48.

Report of JAMES JARDINE, Esq., C.E., *respecting Eyemouth Harbour.*

Edinburgh, August 22, 1837.

No. 48.
Jardine, respecting the Harbour.

EYEMOUTH is situated on the east coast of Scotland, eight miles N.N.W. from Berwick-on-Tweed, and three and a half miles S.E. from St. Abb's Head.

The harbour is well protected by the new pier, designed by the immortal Smeaton, and the bay is well sheltered from all the winds, except the N.W., N., and N.E.

The harbour, however, is not deep enough at low water for the ordinary export corn trade, and there are three *skiers* or ridges of grauwacke rock running quite across the harbour, on which ridges there are respectively only 1 foot 6 inches, 1 foot 4 inches, and 9 inches of water at low water of an ordinary spring tide. These skiers should be cut away, and a sufficient quantity of the rocks opposite the old pier, so as to allow vessels to pass in and out, and *turn* with safety when there is a line of vessels laid along the old pier loading and unloading. The expense of cutting away the skiers and rock above mentioned will be about 300*l.*

Eyemouth is admirably adapted for a herring-fishing station, where a boat-harbour might be excavated in the rock, under the shelter of the new pier, at an expense of from 900*l.* to 950*l.*

The bay of Eyemouth is capacious, deep, and capable of good shelter, and well deserves the attention of Government as the site of an Asylum Harbour.

A breakwater, constructed between the Buss and Hurcar, one between the Luffhard and the shore, and between low water and the shore at A B, would protect the bay or outer harbour—into and out of which ships of the largest class might take either passage, that best might suit the wind for the time. These breakwaters might be constructed at a comparatively small expense, as good materials for the purpose are close at hand.

The shore road to the old pier being mostly washed away, might be repaired for 250*l.*; but it becomes a matter of consideration for the Harbour Trustees, whether they should repair the old road, or buy up some old houses and open a new road, and allow the waves to spend themselves upon the loose shingle beach. It may, however, be added, that were the middle breakwater erected, it would be sufficient to protect the old road, without any bulwark in front of the road.

JAMES JARDINE.

No. 49.

Memorandum by Admiral SIR DAVID MILNE, G.C.B., *in regard to Eyemouth Harbour.*

October, 1837.

No. 49.
Memorandum by Sir David Milne, in regard to Eyemouth Harbour.

HAVING carefully examined the bay of Eyemouth, and taken the bearings (per compass) of the different rocks and points, and the north and east entrance to the bay, with the depth of water in the bay at low water spring-tides,—

I am of opinion, that if the north passage were shut up from the rock called the Luffhard to the rock called the Briggs, bearing from each other east and west, it would make a secure anchorage and Harbour of Refuge for vessels which might be embayed or disabled in bad weather between St. Abb's Head and the Fern Islands. In winter when bad weather prevails, and the wind is from the eastward or E.N.E., small vessels, particularly coasters, which are often badly manned and ill-found in sails and rigging, cannot clear the land on either tack, and nothing can save them from shipwreck on this iron-bound coast, where all hands must perish. This, I know, has often been the case. But were Eyemouth bay made a Port of Refuge, it would become a safe anchorage in bad weather, and would be the means of saving such vessels, much property, and many lives. This can be easily accomplished by filling up the north passage with stones, of which there are abundance on the spot. They could be transported on a few yards of railway, and tumbled into the passage with little cost or labour. When filled in to the high water mark, or nearly so, it would completely break the sea, which at present tumbles into the bay

APPENDIX C.

EYEMOUTH.

No 49.
Memorandum by Sir David Milne in regard to Eyemouth Harbour.

with tremendous violence in north and north-east gales. This, I think, might be effected at no great expense; and the depth of water inside is such, that vessels of considerable burthen, and all kinds of coasters, would find a safe retreat during easterly gales, when they could not clear the land if they continue at sea. The eastern passage is safe and wide. The direct entrance is east and west, and when vessels round the rocks called the Hurcar and Briggs, (on which should be a beacon, painted white, and of sufficient height,) the vessels running in have only to port their helm, and let go their anchors in deep and smooth water.

Along this dangerous coast, there is no port of safety at present for vessels which get embayed between Dunbar and the Fern Islands. Berwick, with easterly winds, from its narrow entrance, and heavy sea breaking on the bar, cannot be attempted in bad weather. Eyemouth bay is perfectly safe to approach, and is easily known from conspicuous land-marks, and a sufficient depth of water for any merchant vessel to anchor in, from 4½ to 5 fathoms.

As a Harbour of Refuge on this dangerous coast, I would strongly recommend it to the attention of Government, for a grant of money sufficient to defray the expense of filling up the north passage, and thereby making a safe and smooth water anchorage for vessels wind-bound or in distress. Should this plan be adopted, Eyemouth would become the first fishing station in the kingdom, both for the herring and deep sea fisheries; where now, under all its present disadvantages, considerable quantities of fish are cured, and exported to foreign countries. The fish are of the finest kind, the cod, &c. being greatly superior to those caught at Newfoundland. Any quantity can be caught at no great distance from the land; and should the bay be improved, so as to give shelter to vessels, a very large export trade of fish would be carried on, where there are such facilities for curing and packing them. It would also be the means of bringing forward a great many hardy seamen for the service of the country. There is just now commencing a salmon fishery along this part of the coast, which promises to be productive. Should the improvement of the bay take place, steam-vessels of any size might anchor, to carry away not only the fish, but also the agricultural produce of the neighbouring county. The town of Eyemouth is a ready-money market for all kinds of grain, of which large quantities are sold at this place; but should the anchorage in the bay be improved, much more would be brought for sale, as it could then be shipped with safety and rapidity. The fishing-smacks which supply the London market with turbot, cod, haddock, &c., would find it greatly to their advantage to rendezvous at Eyemouth, instead of going to the mouth of the Frith of Forth to purchase them from the fishing-boats in that quarter,—in consequence of which, they are frequently obliged, in bad weather, to run up the Firth for shelter, which makes their passage to London long and uncertain; and from Eyemouth, the passage being shorter, the fish would be delivered in a fresher and better state, and the vessels could go to sea at all times, and with any wind. I may add, that some coal seams have been lately discovered in the neighbourhood, which are now worked. This colliery, by the fuel it affords, is a great accommodation to the shipping, and not less so is the abundant supply of good water, which can be obtained both from the river Eye and from a fine spring of water near the beach, where casks can be filled.

In short, should this improvement take place, Eyemouth would be a place of the greatest importance, not only for fisheries to a large extent, but for the establishment of manufactories—and the export of all kinds of agricultural produce.

D. M.

No. 50.

Report on proposed Improvements on Eyemouth Harbour, by JOSEPH MITCHELL, Esq., C.E.,

Office of Highland Roads and Bridges, Inverness, June 22, 1840.

No. 50.
Mitchell, on proposed Improvements.

THE Trustees for Eyemouth Harbour having requested my opinion as to the improvement of that port, and its capabilities, I find, in the *first* place, that great inconvenience is experienced by the quantities of sand and gravel which are carried down by the river Eye, and deposited at the turn of the river, nearly opposite Gunn's Green House. By this means, vessels of heavy burthen are prevented from mooring along the sheltered wharf above the west pier, and considerable expense is incurred annually, in the expedient of excavating the gravel at low water.

Second, Increased accommodation and shelter are much required along the said wharf, or elsewhere, for the numerous shipping and fishing craft which now frequent this port.

And, *third,* the practicability of converting the bay of Eyemouth into a Harbour of Refuge for the vessels which are constantly passing along the coast, and which have no means of protection in stormy weather, between the Fern Islands and the mouth of the Firth of Forth.

The inner basin, or wharf, affords ample shelter for vessels which enter the harbour, but they are necessarily of light burthen, both on account of the deposit lodged at the entrance of it, as already stated, and of the shallowness of the basin itself, as well as from the accumulation of mud which is occasionally deposited there. The shelter, however, which it affords, and its immediate vicinity to the town, would render increased depth at this place, and increased accommodation, very desirable. But to obtain this, it would be necessary both to increase the depth of the basin for several feet, and to build a wharf down the centre of the river, sufficient for vessels to go alongside and discharge their cargoes. This arrangement, although it would very materially improve the accommodation now afforded, would not, I fear, give the satisfaction which might be anticipated, as the space or area, considering the unlimited extent to which the fishing may be carried, would be very inadequate to the expense. Moreover, without carrying down the centre wharf to a much greater length, the deposit from the river would still be inconvenient to vessels in entering the harbour, as the only way of remedying this evil is by diverting the river channel, and contracting its course, so that the impetus of the flood waters may clear the deposit away; or adopting the present expedient of excavating it, when it has accumulated to a considerable depth. The former plan is out of the question, (even were it otherwise advisable in point of expense,) and the only practicable remedy which I can suggest is, to select some flat part of the river channel above the harbour, and drive a row of common piles, from 3 to 4 inches in diameter (such as are used for pit props,) about two or three feet apart, and filling up the intermediate spaces with wattle-work. These piles should be driven about 2 feet 6 inches to 3 feet into the bed of the river, and raised about one foot above the ordinary surface of the water—the wattling being carried up to the full depth of the water. This would form a sort of fall for the river of perhaps a foot, and all the debris from the upper country would necessarily deposit in the still water above this barrier. By this means,

APPENDIX C.

EYEMOUTH.

No. 50.
Mitchell, on proposed improvements in the Harbour.

when the water is very low during summer, a few men with horses and carts could remove the accumulated materials, as access can be had to it much more easily than at the mouth of the basin, and no inconvenience will be experienced by the shipping.

From the limited accommodation which this upper basin or wharf would afford, in comparison to the expense necessary for its improvement, I would not deem it advisable to do anything to it beyond repairing the wharf, where necessary, and the centre dyke, which appears now in a somewhat dilapidated state, and perhaps clearing away the mud in the interior, as far as the safety of the foundations of the wharfs would warrant. This would afford ample wharfage for the vessels trading to the port; and, in order to secure accommodation and shelter for wind-bound vessels, and the shipping and boats connected with the fishing, I would recommend a new harbour immediately behind the new pier. At this place I propose excavating a basin and fairway, as shown in the enlarged plan for the whole area, tinted *red* to the full depth of low water of spring-tides; and by constructing a breakwater from the end of the new pier along the river channel, nearly parallel to the west pier, this basin would be fully sheltered from any run of sea which comes up the course of the river. But indeed this is very inconsiderable, as, from the shelter of the high rocks of the fort, and the direction of the new pier, the run is little or nothing, even when there is a considerable swell in the bay. This breakwater would afford commodious wharfage to ships; and I propose building a wharf on the upper or land side of the basin, which might, during the fishing season, be made available and profitable as a curing station.

I propose also building a small head at the entrance of this harbour, as a protection to vessels; but I do not continue the line of wharf there, in case, after these works should be constructed, increased space and accommodation in that direction may be required.

The expenses of completing this work, as shown by the detailed estimate, will amount to 2,944*l.* 17*s.* 1*d.* But should the trustees in the meantime deem it inexpedient to incur so large an outlay, the excavation to low water may be limited to the fairway and 60 feet from the inside face of the breakwater, and the basin then sloped up with a regular inclination, as shown on the sections and plans. The upper wharf would also be dispensed with. This would reduce the expense to 2,060*l.* 14*s.* 3*d.* But I would much prefer the basin and wharfs according to the more extended plan.

I am of opinion that this basin will afford every accommodation and shelter for wind-bound vessels and fishing craft, and its proximity to the mouth of the river will afford a ready entrance and exit, which, to the class of vessels it is particularly intended to accommodate, is of no small importance. And as this basin will afford from 1 foot to 18 inches of additional depth of water, to that now at the present wharf, this also will be an additional advantage.

The total expense therefore of these improvements will be—

	£.	s.	d.
Completing New Harbour	2,944	17	1
Constructing Weir of Wattle-work	12	0	0
Repairs of Upper Basin or Wharf	150	0	0
Making Road from New Harbour along the river side	116	0	0
	3,222	17	1
Or, if the plan of limited excavation is adopted .	£2,338	14	3

It has been suggested that a light at the end of the new pier, and another at a point on the shore, which would lead vessels and boats by the north-east passage, would be very advantageous; and that also a stone beacon on the Hurcar rock, painted *white*, would be valuable in directing strangers into the safe channel of the bay. I should imagine there can be only one opinion on this point, and I shall send a sketch of the beacon for the Hurcar rock, if required. But as to the lights;—unless it were determined what expense could be afforded, it is impossible for me to speak. I have seen a very useful expedient adopted, which I think might answer here, viz.—To erect a stout pole at the end of the pier, and have a reflector lamp hoisted on it by the pilots or harbour master, at such times as might be fixed on. This perhaps would cost from 15*l.* to 20*l.* But unless the fishermen contributed something in the shape of dues, I suspect such accommodation as this should be provided by themselves.

In regard to the practicability of constructing a breakwater, as suggested by Sir David Milne, in his note for the improvement of Eyemouth harbour, there appears to me no difficulty whatever, unless the smallness of the bay and the space to be protected might scarcely be an equivalent for the expense. I have sketched on the plan the form, which appears to me best suited for the protection and security of vessels requiring shelter. By constructing it of the form shown, ships could lie with safety during the prevailing winds which affect this harbour from the north, north-west, and north-east; and such a work would no doubt render Eyemouth a place of much greater importance than at present, besides affording safety and shelter to the valuable shipping constantly passing along the coast. Access, in whichever way the wind might prevail, involving danger, could thus be had to the bay. For the construction of this breakwater there is an ample supply of rock to the north of the fort, which might be thrown in from the quarries by a railway placed on an inclined plane, so contrived, that the loaded waggons might take up those discharged. I have sketched a cross section of such a work, giving the outer slope an angle with the horizon of 24°, and the inner slope an angle of 33°; and I annex a rough estimate of the probable expense.

But before giving any definite opinion in regard to this, I should like to be put in possession of the chart and soundings taken by Captain Slater, by order of the Admiralty. The form of the rocks, the depth of the water, and the nature of the beach, will be accurately shown and explained by that eminent surveyor; and it is a document which, if compatible with the rules of the Admiralty, the trustees of Eyemouth harbour should be possessed of, in the contemplation of their intended improvements.

JOS. MITCHELL.

Rough Estimate for making a Breakwater in the Bay of Eyemouth.

Length of larger Breakwater 1000 feet } requiring 207,377 cubic yards of stone, £46,106.
" smaller " 330 " }

No. 51.
Report and reply thereto, by Robertson, to the Directors of the National Floating Breakwater and Refuge Harbour Company.

No. 51.

Report submitted to the Directors of the National Floating Breakwater and Refuge Harbour Company, by JAMES SAUNDERS ROBERTSON, *Writer to the Signet.*

Eyemouth, January 29, 1842.

THE Reporter came here of this date, (January 28th, 1842,) and met with Thomas Bowhill, Esq., solicitor in Eyemouth, and William Allan, Esq., wood merchant there, two of the Harbour Trustees. These gentlemen communicated to the Reporter a variety of plans and reports relative to certain proposed improvements of the harbour of Eyemouth. From the plans and reports, the Agent selected those to be mentioned in the sequel, and subsequently met with Mr. James Trotter, parish schoolmaster, and Robert Craig, pilot and fisherman at Eyemouth. Mr. Trotter was directed by the Harbour Trustees to copy a plan prepared by Joseph Mitchell, Esq., Engineer to the Fishery Board—the plan which appeared to the Reporter to be the most ample and distinct of those submitted to him. The copy prepared by Mr. Trotter will accompany this Report, and to that copy the Directors are respectfully referred. The papers selected, and of which copies are herewith transmitted, are—

1st. Memorandum by Admiral Sir David Milne, of Milnegradon, dated October, 1837.

2nd. Report respecting Eyemouth Harbour, prepared by James Jardine, Esq., civil engineer, dated August 22nd, 1837.

3rd. Estimate for a making a Breakwater in Eyemouth Bay, June, 1840.

4th. Report on proposed Improvement of Eyemouth Harbour, by Joseph Mitchell, Esq., civil engineer, dated June 22, 1840.

The Reporter this day (January 29th, 1842) went in a boat with Robert Craig, from a point beyond "Tam's-stane," round by Blackcar, Luffhard Buss, Buss Craig, Hincar, Hurcar, Nest End, Lady's-Pool, and Nettlescar, to the point from which they started. The distance between the outermost rock—say Hurcar, and the shore at Eyemouth, close by the houses, is about three quarters of a mile. The distance between the point of the old pier and the point of rock somewhat to the south of "Tam's-stane," was paced twice by Mr. Allan alone, and once by that gentleman and the Reporter in company, and the paces measured by a hand rule at intervals. The three measurements did not vary above a foot or two, and the distance was thus ascertained to be about 852 feet.

The distance between the different rocks at low water (at which time the inspection was made) were estimated by Robert Craig, who has been acquainted with the bay and harbour for upwards of 36 years, as follows :—

1st. Between Buss and Buss-Craig . . .	15 or 16 feet.
2nd. Between Buss-Craig and Hincar . .	30 or 40 „
3rd. Between Hincar and Hurcar . . .	45 to 50 „
4th. Between Briggs and Hurcar . . .	15 to 16 „
5th. From Hurcar to Nest-End, . . .	540 „
6th. From Nest-End to Lady's-Pool, also about	540 „
7th. From Lady's-Pool to Nettlescar . .	270 „
8th. From Nettlescar to the Shore, about .	600 „

It will be seen on referring to the plan, that the river Eye empties itself into the ocean at the outer end of the old pier. This river, when in flood, comes down with great rapidity, and makes a considerable swell. The bay is one of great beauty, the bottom is rocky, but is covered towards the shore with sand, small stones, and shingle. The rocks appear to be all of the same kind, viz., whinstone. The place called the Fort is composed of granite, part of it pudding-stone, and at one place it is stratified. The Reporter has obtained specimens of all the stones marked Nos. 1, 2, 3, 4, and 5, as labelled.

The general opinion of those best acquainted with the locality seems to be, that, in order to make the harbour most efficient as a Refuge Harbour, it would be necessary to have a breakwater running from Nest-End towards Hurcar, thence to Buss-Craig, to Buss, and thence to Luffhard, leaving a sufficient space for the entrance of vessels from due north into the bay; and with this opinion the Reporter humbly coincides.

It is requested that an estimate of the expense of a floating breakwater to inclose the bay from the points indicated in this report, shall be transmitted to Mr. Bowhill. The Reporter cannot conclude without noticing the marked civility he, as servant of the Company, has met with from all the gentlemen connected with the harbour at Eyemouth.

All which is humbly reported by

JAMES S. ROBERTSON.

Letter from John Charretie to Mr. Bowhill, February 8, 1842.

Letter from JOHN CHARRETIE, Esq., *Secretary National Floating Breakwater and Refuge Harbour Company, to* Mr. BOWHILL, *February* 8, 1842.

SIR,

AGREEABLY to the wish of J. S. Robertson, Esq., W.S., of Edinburgh, and Agent to this Company, I take leave to send you an estimate of the charge that would be made by this Company for forming a safe and complete Refuge Harbour in Eyemouth bay.

I perceive by the chart forwarded to me, that it has two entrances—one I shall call the northern, and the other the eastern. Effectually to protect the northern entrance by the use of Captain Taylor's Floating Breakwater, the cost would be 10,000*l.*, including every expense of timber, building, anchors, chains, moorings, &c. The sections would either run in a line from Luffhard to the Buss, or from Luffhard to the Briggs, which would make the expense near 1000*l.* more, and give you less anchorage. To protect the eastern entrance it would cost 7500*l.*, and, should the parties desire it, an entrance either through one or both channels might be arranged. If you think that, by shutting up the northern entrance, and leaving the eastern as the common channel, it would give you sufficient protection, your harbour would then only cost you 10,000*l.*; and if at any future period you found that you required still further protection, you could then shut up so much of the eastern channel as would effect your object, the whole cost not exceeding 17,500*l.* Any explanation of this statement, or any other that I can give you on this interesting subject, I pray you will command.

I am, &c.,

JOHN CHARRETIE.

No. 52.

Unto the Right Honourable the Lords of the Treasury, the Memorial of the undersigned Merchants, Shipowners, Traders, Seamen, Fishermen, and others interested in having a Harbour of Refuge on the East Coast of Great Britain, and particularly in that part of the Coast situated between the Firth of Forth and the Humber;

No. 52.
The Memorial of the undersigned Merchants, Shipowners, Traders, Seamen, Fishermen, and others interested in having a Harbour of Refuge on the East Coast of Great Britain, and particularly in that part of the Coast situated between the Firth of Forth and the Humber.

HUMBLY SHEWETH,

THAT great inconvenience to the trade and commerce of the country, as well as much loss of life and property, arise from the want of safe harbours on the east coast of Great Britain, and particularly in that part of it situated between the Firth of Forth and the Humber.

It is well known that, except in the Firth of Forth, no place exists on the south-east coast of Scotland which coasting vessels can resort to, either when they are wind-bound, or when they are in distress. Even in the Firth of Forth no harbour exists which is not dry at every tide, or which vessels of any size can reach, without going about 80 miles out of their course. Nor is there a bay or roadstead in the said Firth where vessels can anchor in safety, in a north-easterly or south-easterly gale, or which they can reach without a considerable deviation from their course.

Between the Firth of Forth and the Humber (an extent of coast measuring more than 200 miles,) there is absolutely no harbour, and not even a bay, to which ships or trading vessels can run for shelter in easterly gales. Further, there is no harbour in that long tract of coast which can be entered by any vessels, *except at high water;* and not more than two can be entered even then by coasters of a large size.

But your memorialists do not think it necessary to say more on this subject, as it is one which is well known to every intelligent person, and as, moreover, it was made the subject of very recent inquiry by a committee of the House of Commons.

This committee was appointed "to inquire into the alleged deficiency of protection for ships on the north-east coast of England, and the propriety of admitting of contribution of passing tolls for the maintenance of Harbours of Refuge on that coast."

The committee was appointed on the 22nd March, 1836, and a very interesting report was presented by them to Parliament on the 16th June, 1836.

A great number of witnesses were examined by this committee, in reference to the want of harbours and places of shelter along the north-east coast of England. Some of these witnesses were extensively engaged in trade and navigation; others were not connected with mercantile or shipping interests, but were officers in the Royal Navy of great experience; others had been employed in the command of steam-vessels used chiefly for the transport of passengers between Leith and ports to the south. The testimony of all these persons was conclusive as to the non-existence of any harbour between the Firth of Forth and the Humber, to which ships and vessels trading on the east coast could resort, either for shelter or for repairs, or during severe contrary winds.

Your memorialists might also refer to the report of that committee, and more especially to the evidence laid before it, for a statement of the disadvantages to which the most important interests of the country, and the dangers to which a large portion of its most industrious population are subjected, by this state of things. These disadvantages and dangers were not, however, set forth in the said report, or made apparent to the committee, to their full and actual extent. The evidence regarding the number of shipwrecks on the east coast, and the various injuries to the mercantile and shipping interests there, chiefly regarded such as occurred on that part of the coast *south* of Newcastle. No evidence was led as to the evils arising from the same cause on that part of the coast between the Firth of Forth and Newcastle—though they are of such magnitude as to deserve the immediate and most serious attention of the Legislature.

It cannot be necessary to point out the extent and value of the trade which is carried on along this part of the coast, by ships, vessels, and boats, and the necessity which exists of providing for their accommodation and safety. But your memorialists may be permitted to mention, that besides the ordinary shipping trade of this part of the island, new sources of commercial enterprise have been recently opened, for which the existing harbours are wholly inadequate. One great cause of the additional shipping in this part of the island arises from a trade having been lately opened with Australia and China, and for which large ships periodically sail from Aberdeen, Dundee and Leith. Moreover, within the last few years, a number of steam-vessels have begun to ply on this part of the coast, which are chiefly occupied in the conveyance of passengers, whose comforts and even personal safety are greatly dependent on the existence of harbours accessible at all times.

Your memorialists, deeply impressed with the great benefits which would accrue to the country and community at large, by affording protection and accommodation to the ships and vessels thus trading along this part of the east coast, would very respectfully but very urgently recommend, that, if possible, one or more harbours of refuge should be made in it. They are themselves all more or less connected with, or interested in, the trade and commerce now carried on there; and they can bear testimony to the great advantages that would thereby be conferred on the mercantile and shipping interests of the country.

Your memorialists, in furtherance of this important object, would earnestly solicit attention to the bay of Eyemouth, in the east coast of Berwickshire, as a place eminently well adapted for being converted into a Port of Refuge. They are informed, that this place has lately been examined by Mr. James Jardine, civil engineer, Edinburgh, with a view to ascertain its capabilities. From his report, and the plan of the bay referred to in it, it appears that the bay is nearly of a circular form, of 500 or 600 yards in diameter, and to which there are two entrances from the ocean. This bay, for one-third of its area, is (at low spring tides) no less than six fathoms deep, and is throughout, on an average, three fathoms deep. Mr. Jardine observes, that "the bay of Eyemouth is capacious, deep, and capable of good shelter, and well deserves the attention of Government, as the site of an Asylum Harbour. "A breakwater" (he adds) "constructed (so as to block a part of both entrances,) would protect the bay or outer harbour,—into and out of which ships of the largest class might take either passage that best suited the wind for the time. These breakwaters might be constructed at a comparatively small expense, as good materials for the purpose are close at hand."

Your memorialists may explain, that a small river runs into the bay of Eyemouth, and that a town is situated there, which carries on a very considerable trade. About forty years ago a pier was erected, so as to form a harbour. This pier was erected by the celebrated Smeaton, in whose posthumous works will be found his report on the bay and harbour of Eyemouth, and in which he describes

APPENDIX C.

EYEMOUTH.

No. 52.
Memorial of the Merchants, Shipowners, Traders, Seamen, Fisherman, and others interested in having a Harbour of Refuge on the East Coast of Great Britain, and particularly in that part of the Coast situated between the Firth of Forth and the Humber.

the former as well adapted for the accommodation of vessels. In consequence of the shelter and conveniences afforded by this bay and harbour, it is frequently filled by vessels not connected with the port, during the severe easterly gales which, in winter and spring, render the navigation of this part of the coast so dangerous. During the winter of 1836-37, there was, on one occasion, upwards of forty coasters in Eyemouth Harbour, in which they had taken refuge from stress of weather. It is well known that this part of the coast is particularly dangerous to mariners, and that scarcely a winter passes without several wrecks on it. It appears that, from the set of the tides and other causes, vessels are very apt to get embayed between St. Abb's Head and the Fearn Islands; and it would be, therefore, most serviceable to have a Port of Refuge to which they could, in these circumstances, resort. This is a matter well known to all naval officers and seamen who have frequented this part of the coast; and your memorialists cannot, in proof of it, do better than refer to the accompanying memorandum, by Vice-Admiral Sir David Milne. It will be seen what his opinion is of the dangers to which vessels are exposed on this shore, and of the great capabilities of Eyemouth bay as a place of complete and convenient shelter.

Your memorialists may refer also to testimony of another kind, regarding the fitness of this place for a Port of Refuge. It is well known that there exists in Scotland, under the authority of Parliament, a Board, whose peculiar duty it is to encourge the cod and herring fisheries of Great Britain, and to execute on harbours any improvements which may be useful to these fisheries; and, for this purpose, they receive every year a Parliamentary grant of 2000*l*. One of the most important stations for the cod and herring fishery is at Eyemouth. It is calculated that, during the herring season, there are not less than 100 large boats, and 1000 persons employed at that port in the trade. An application was lately made to the foresaid Board to execute certain works, with the view of affording better accommodation to the fishing-boats, either by improving the existing small harbour, or else by putting a breakwater at the mouth of the bay, so as to convert it into one large and commodious harbour. The application was very deliberately considered by the Commissioners of the Fishery Board; and the following answer was made to it:—

Office for the Herring Fishery, Edinburgh,
January 16, 1838.

DEAR SIR,

THE Commissioners for the Herring Fishery have had under consideration your letter of September 21st last, with its accompanying papers, requesting assistance for the erection of a harbour at Eyemouth; or submitting, in lieu thereof, that the *Bay* of Eyemouth may be converted into a *Harbour of Refuge*, by the erection of breakwaters in certain parts of it,—I am directed to acquaint you, for the information of the parties concerned, that *the Commissioners are satisfied that the Harbour of Refuge on the south-east coast of Scotland would be a great national benefit*, and that *the Bay of Eyemouth* appears *extremely well calculated for the purpose*; but the expense of such a work is so far beyond *their* means, that they have it not in their power to engage in the undertaking.

The Commissioners, however, consider the matter of such *importance*, that *they recommended* that a memorial on the subject should be addressed to the Board of Trade and the Lords of the Admiralty; and it will give them much pleasure to find that the application is attended with success.

I remain, &c.,
JAS. DUNSMURE.

To David Milne, Esq

Your memorialists refer to the foregoing letter with the more confidence, and they are sure it will carry with it all the more attention and weight, that the Commissioners of the Fishery Board, whose unanimous opinion it expresses, were informed before the letter was written, that it would probably be laid before Government, in support of the present memorial. The Commissioners, whose opinion is expressed in the above letter, were Lord Abercromby, Sir Henry Jardine, Sir Thos. D. Lauder, Adam Hay, Esq., banker, Edinburgh, Robert Graham, Esq., of Redgorton, and the Lord Advocate of Scotland.

Your memorialists, under these circumstances, would urge very strongly upon the Government the expediency of appointing some engineer of eminence to visit the bay of Eyemouth, and report both as to the practicability of converting it into a Harbour of Refuge, and the expense which would be required for that purpose. It appears, from the papers laid before the Fishery Board, that the bay, independent of the harbour, is capable of containing at least 100 coasters, drawing from 10 to 30 feet, and that, if the proposed breakwater were erected, they would lie there in perfect safety. Your memarialists are informed, that the cost of the breakwater would certainly not exceed 20,000*l*.; and it is humbly thought that such a sum is not too much for this great country to expend, for the attainment of an object so advantageous to the empire at large.

Your memorialists have procured the papers on this subject, which were laid before the Commissioners of the Fishery Board, and they are sent with this Memorial, in order to afford any additional information which may be desired.

No. 53.
Petition of the Shipping Companies, Merchants, and Shipowners, belonging to Leith, Dundee, Mussel-

No. 53.

Unto the Right Honourable the Lords Commissioners of the Admiralty, the Petition of the Undersigned Shipping Companies, Merchants, and Shipowners, belonging to Leith, Dundee, Musselburgh, &c.

HUMBLY SHEWETH,

THAT your petitioners beg leave to represent to your Lordships the great dangers and disadvantages to which they are exposed, in common with many other classes of the community, from the want of safe and commodious harbours on the east coast of Great Britain.

Your petitioners are all connected with the shipping interests of that part of the empire; and they have therefore especial knowledge of the evils now alluded to. It is only necessary to allude to the fact, that between Cromarty bay, in the north of Scotland, and the river Humber, on the south coast of Yorkshire, (a tract of 400 miles), there exists only *one* place of refuge to which vessels of any burden can resort to at all, viz., the Firth of Forth. Even there, they cannot find shelter in *all* winds; and when they do resort there, they have generally to run up to the Queensferry, in consequence of which they deviate 40 or 50 miles out of their course.

No. 53.
Petition of the Shipping Companies, Merchants, and Shipowners, belonging to Leith, Dundee, Musselburgh, &c.

It is true there are many small harbours both to the south and to the north of the Forth: but they are most of them left dry twice in the 24 hours, by the receding tide,—or else they are situated at the mouths of rivers, the bars of which rarely allow safe access to them. This deficiency is felt most severely along that part of the coast south of the Firth of Forth, where the coasting trade is carried on to a vastly greater extent than to the north of the Firth. In order to acquire some idea of the risks and losses to which your petitioners are exposed from the want of harbours along that line of coast, it is only necessary to refer to the number of shipwrecks which annually take place on it. Your petitioners have been unable to obtain accurate information as to the wrecks along the whole line of coast between the Firth of Forth and the Humber; but they have ascertained the number of wrecks which occurred along a small portion of that coast, viz., between the Firth of Forth and Holy Island, during the following years:—

In 1823,	there were	23	vessels wrecked there.	
1824,	"	12	"	"
1827,	"	13	between Dunbar and	Fern Islands.
1830,	"	4	"	Holy Island.
1831,	"	7	"	"
1832,	"	4	"	"
		58		

being, on an average, ten vessels annually along a line of coast not more than 49 miles in extent.

Besides these instances of shipwreck, the petitioners might advert to the loss of three men-of-war, which took place at an earlier period, in the same part of the coast now alluded to. But it is unnecessary to go back on former years. The last winter (of 1837-38) has afforded sufficient proof of the evils and losses arising from want of harbours—there having been within twenty miles of St. Abb's Head, no less than five wrecks, and in two of these the crews all perished, and every portion of the cargoes was lost.

Your petitioners understand, that, with a view to obviate this frequent loss of human lives, and the destruction of property as well as the great inconveniences to trade and commerce arising from the want of harbours on the east coast of the island, it was proposed to form an Asylum Harbour at Redcar, situated on the coast of Yorkshire. The expense of this harbour, it was estimated, would amount to 350,000*l*. But your petitioners would humbly venture to offer it as their opinion, that the object in view would be far more effectually attained, if the funds to be devoted to it were expended, not in the formation of one large and capacious harbour, but in the formation of several small harbours, situated at convenent intervals along the coast; for it must be obvious to your Lordships, that vessels, when overtaken by a storm, or otherwise in such circumstances as to require shelter, would generally be so far from any single port, as to derive no benefit from it at all. Whilst there are strong reasons why an asylum would be useful at Redcar, (to the south of the Tyne,) there are also reasons equally strong for the formation of a similar harbour to the north of the Tyne, and, in particular, between the bold promontory of St. Abb's Head and the Fern Islands. At this part of the coast, sailing vessels in easterly gales are very apt to get embayed, and, therefore, at that part of the coast the formation of an Asylum Harbour would be extremely desirable.

Your petitioners would earnestly entreat your Lordships to bestow on this subject that consideration which, on account of its great national importance, it deserves; and to ascertain, by the report of eminent engineers to be selected by your Lordships, what places are capable of being made into Asylum Harbours. In this way, satisfactory and impartial information would be afforded to Government and the country, as to the best means of remedying the evils in question.

Your petitioners would only farther add, that they entirely disapprove of any plan of taxing a particular portion of the community, for raising funds in order to form such harbours. They consider that the object is one of such importance to the empire as to justify and call for an application of public money; and they have no doubt that Parliament would readily approve of such an application.

May it therefore please your Lordships to take the premises into consideration, and adopt such measures, as may appear the best suited to attain execution of the above object.

And your petitioners will ever pray.

No. 54.

No. 54.
Petition of the Merchants, Corn-dealers, Fish-curers, and Fishermen in Leith and Newhaven.

Unto the Right Honourable the Lords Commissioners of the Admiralty, the Petition of the undersigned Merchants, Corn-dealers, Fish-curers, and Fishermen in Leith and Newhaven;

HUMBLY SHEWETH,

YOUR petitioners beg leave to address your Lordships on a subject in which they are deeply interested, and which, as it humbly appears to them, is one of public and even national importance.

Your Lordships must be well aware of the encouragement afforded to the trade and commerce of the country, by the existence of safe and convenient harbours. When vessels have encountered damage of any kind, or when, from severity of weather, it is expedient to take shelter, or when, from contrary winds, they can make no speed on their voyage, in all these cases the utility of safe and convenient harbours on a coast is very desirous. Your petitioners need not point out to your Lordships the great additional expense which is necessarily incurred when vessels are obliged to keep at sea in such circumstances, or the loss of lives, merchandise, and other property which frequently ensues. These consequences are well known: and they severely affect your petitioners, who are engaged in the trade, commerce, and fisheries carried on along the east coast of Great Britain.

Your petitioners regret to say, that on the east coast of Great Britain, and particularly on the Scotch coast, these evils and disadvantages are quite unprecedented; and they arise entirely from the want of harbours. For there exists not a single harbour between the Firth of Forth and the Humber (a tract of coast exceeding 200 miles in extent) to which vessels of any considerable burden can at all times of the tide resort; and which even at high water they can approach with safety in easterly gales. The same deficiency of harbours exists farther north. Between the Firth of Forth and Cromarty bay, there is no port of refuge, which in such circumstances affords any shelter to vessels trading along the coast.

APPENDIX C.

EYEMOUTH.

No. 54.
Petition of the Merchants, Corn-dealers, Fish-curers, and Fishermen in Leith and Newhaven.

Your petitioners cannot but think that the evils and disasters arising from the want of such harbours on the east coast of England and Scotland, are of such a nature as urgently to require an immediate and effectual remedy. They have been the subject of frequent discussion in Parliament, and a committee was appointed to consider the places best adapted for the formation of Asylum Harbours on the east coast. That committee reported unanimously on the necessity of having several such harbours;—but they were unable, from deficiency of information, to recommend more than one place where a deep and convenient Asylum Harbour could be formed. Your petitioners understand that the place so recommended by the committee was Redcar, situated on the Yorkshire coast, and considerably to the south of the river Tyne.

It is hardly necessary to say, that one Asylum Harbour, on such an extensive and dangerous line of coast as that which exists between the Firth of Forth and the Humber, could afford but a very partial remedy for the existing evils. Indeed, it humbly appears to the petitioners, that, instead of having one large Asylum Harbour, it would be greatly better to have several small harbours at proper intervals along the coast; for, in that case, there would be a much better chance for vessels obtaining immediate shelter, and there would be less inconvenience and expense occasioned by their having to make a smaller deviation or deflection from their course.

Your petitioners have reason to believe, that between the Firth of Forth and the Tyne, one or two places exist well adapted for the formation of Asylum Harbours; and they earnestly entreat your Lordships to cause these places to be surveyed by engineers of your Lordships' selection, in order that their several capabilities may be fairly and impartially ascertained.

As to the mode of defraying the expense of such harbours, your petitioners beg leave to state, that the object is of such public and national importance, as to justify a Parliamentary grant. The proposal to raise the necessary funds by means of a tax on the vessels which should frequent the several harbours, would go far to prevent their being ever resorted to; and it would be unjust to tax all vessels promiscuously which sail along the east coast, whether they resort to the harbours or not. Indeed, it would be in any view unfair to throw upon the shipping interest alone the expense of a measure, which would not only benefit them, but would benefit also other classes of the community, and which, by obviating the loss of life and destruction of property, seems to be necessary on the still broader grounds of humanity and public expediency. Your petitioners know that grants of public money are made for other objects far less urgent, and far less useful, than that which your petitioners now venture to recommend to your Lordships' notice; and they feel assured, that, if an application were made to Parliament for such sums as may be required for this object, it would be at once acceded to.

Your petitioners would therefore humbly entreat your Lordships to take this matter into your serious consideration, and appoint an engineer of experience and ability to survey the different places on the east coast of Great Britain, and particularly that part of it north of the river Tyne, including the Scotch coast; so that a report may be obtained, and be laid before Parliament, as to the capability of such places for being converted into asylum harbours, and the expense thereof in each case.

Besides the foregoing petitions, there were others sent by the Merchant Company of Edinburgh, by the General Steam Navigation Company, and various other societies interested in the formation of an Asylum Harbour, on the east coast. All of these contained the expression of an opinion, that Eyemouth bay, from its situation and its capabilities, ought to receive the especial attention of government.

The petition of the Merchant Company of Edinburgh was sent to the care of Sir John Campbell, then M.P. for Edinburgh. He returned to R. Thomson, Esq., the Master of that Company, an answer, from which the following is an excerpt:—

MY DEAR SIR, *London, April* 23, 1838.

I have presented your petition to the Admiralty; and I have every reason to believe that it will meet with the attention which its importance deserves.

Mr. Ferguson of Raith, then M.P. for East Lothian, took charge of the petition or memorial by the Steam-Packet Company, and he thereafter wrote regarding it as follows:—

MY DEAR SIR, *Portman Square, May* 5, 1838.

I only received the memorial you announced in your letter of the 28th ultimo two days ago; it had gone by mistake to Cutler Ferguson, who sent it to me. I shall of course lay the memorial before the Admiralty, as that is the proper channel in the first instance; and I have already stated to them that I had such a memorial. But I well know what the reply must be—that Government can advance no funds for such purposes. If such a small sum as 20,000*l.* would be sufficient to make a safe and commodious Asylum Harbour, at all times of tide, at Eyemouth bay, I dare say a joint-stock company might be got to undertake such a work, on receiving as compensation and profit certain reasonable harbour dues, but with no right whatever to levy any toll on passing vessels. The great difficulty of having Asylum Harbours on the east coast appears to be, not being able to accomplish such a harbour for all times of tide; for unless it can be safely entered at low water, it very much ceases to possess the advantages of an Asylum Harbour. As the interests involved in having such a harbour offers to be important and extended, I believe such a speculation by a joint-stock company might be more successful than many of the railroad undertakings are likely to be.

Ever truly yours,
ROBERT FERGUSON.

To R. H. Hamilton, Esq., Edinburgh.

Shortly after this Admiral Sir David Milne and John Spottiswoode, Esq., went to the Admiralty, in order to ascertain what impression had been made there, and on the Government generally, by the petitions above quoted and referred to. They had an interview on this occasion with Sir Charles Adam, then one of the Lords of the Admiralty, and Captain Beaufort, R.N., the Hydrographer of the Admiralty. Mr. Spottiswoode, in a letter written by him to David Milne, Esq., advocate, Edinburgh, immediately after this interview, states—

Captain Beaufort said that it was his individual wish, that Harbours of Safety should be constructed on various parts of the coast, and it was his opinion that the Government of this country ought to set apart a large sum every year for this purpose. At the same time, he said, that he thought that some of the larger bays on the east coast were the first that should be attended to. At the same time, he said he knew that Eyemouth would make an excellent harbour for the size of the bay, and that

APPENDIX C.

EYEMOUTH.

No 54.
Petition of the Merchant, Corn dealers, Fish-curers, and Fishermen in Leith and Newhaven.

probably at no great expense; but it appeared to him that it was a fishing station, that it was most likely that you would be able to get anything done for it, as for that purpose it was admirably adapted. Sir Charles Adam said that Captain Slater is at present employed upon a farther amphibious sort of survey of the coast, and that he will in the course of the season be at Eyemouth. He has promised to direct him, a week before he is to be there, to write to Sir David Milne and let him know, in order that he or you, or any person interested in Eyemouth, may meet him and communicate with him, and get or give any information that may be useful hereafter.

I can easily see that there is not at present at the Admiralty any expectation that Government will at present advance any money towards making Harbours of Refuge even at the most important places.

Notwithstanding the promise made on this occasion by Sir Charles Adam, that Captain Slater should visit Eyemouth in the course of the summer 1838,—this officer never appeared there. This part of the general coast was surveyed in 1839, by one of Captain Slater's subordinate officers; but it is not known that any special survey or report was made even by him on Eyemouth bay.*

Boats and Fishermen on the Eyemouth Station.

No. 55.

No. 55.
Boats and Fishermen on the station.

1. BOATS and FISHERMEN, &c.—An ACCOUNT of the NUMBER of BOATS, whether decked or undecked, belonging to the District of EYEMOUTH, that have been employed in the Year ended the 5th April, 1841, in the Shore, CURING HERRINGS, and Cod and LING FISHERIES—distinguishing the Number of Fishermen and Boys by whom the same were manned—and shewing also the Number of Coopers employed—the Number of Persons employed in gutting, packing, re-packing, cleaning, and drying the Fish—the number of Labourers employed—and the Total Number of all such Persons, together with the Number of Curers in the said District.

Names of Fishing Creeks.	Number of Boats, whether decked or undecked.	Number of Fishermen and Boys by whom the same were manned.	Number of Coopers employed.	Number of Persons employed in gutting, packing, re-packing, cleaning, and drying the Fish.	Number of Labourers employed.	Total Number of Persons employed.	Number of stationed Curers employed.
Spittal	29	127	44	454	32	657	10
Tweedmouth	6	28	4	26	6	64	1
Berwick	7	35	8	60	9	112	2
Greenses	12	60	..	..	..	60	..
Ross	7	30	..	..	..	30	..
Burnmouth	21	99	5	32	6	142	2
Eyemouth	28	125	21	174	22	342	10
Coldingham Shore	24	100	5	20	4	129	3
Red Hough	3	12	..	..	..	12	..
Cove	13	60	2	10	2	74	1
Dunbar	13	62	21	210	24	317	8
Total	163	738	110	986	105	1939	37

Eyemouth, April 15, 1841.—I do hereby certify that the above account is as near as possible.

JOHN WARES, *O. F.*

N. B.—As the Ross, Burnmouth, and Coldingham boats, during the herring season, deliver their cargoes at Eyemouth, and as these creeks are only two or three miles distant from Eyemouth, the boats and trade pertaining to those three places should be classed together, in comparing the extent of the fishery on this part of the coast with that of Dunbar.

2. *Account of the Number of Barrels of White Herrings cured by Fish-Curers on Shore, in the District of Eyemouth, for the Year ending April 5th*, 1841.

Spittal	7343 barrels.
Tweedmouth	1336 „
Berwick	1097 „
Burnmouth	1218 „
Eyemouth	6808 „
Coldingham	200 „
Dunbar	6549 „
Leith	5888 „

3. *Account of the Number of Cod, Ling, or Hake taken or purchased in the* District *of Eyemouth, by the Crews of Open Boats employed in the British Cod and Ling Fishery, for the Year ending April 5th*, 1841.

Spittal	*Nil.*
Tweedmouth	„
Barwick	„
Burnmouth	10,368
Eyemouth	37,470
Coldingham	3,470
Dunbar	*Nil.*

4. *Memorandum given to Mr. Bowhill, Writer, Eyemouth by Mr. Innes, Principal Officer of the Customs at that Port, May*, 1842:—"The number of vessel entering the port is, on an average, 300 yearly. The commodities imported consist principally of timber, salt, drain-tiles, lime, bone-manure, and coals. The exports are corn, potatoes, and fish."—*See* Supplement for similar Return for 1846.

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* A detailed survey of Eyemouth harbour and bay was made by Mr. G. K. Calver, under the directions of Captain Slater, in 1839, a tracing of which might have been procured at any time by an application to the Secretary of the Admiralty.—Ed.

APPENDIX C.

EYEMOUTH.

No. 56.
Statement of the Capabilities of Eyemouth Bay and Harbour for an Asylum Harbour.

No. 56.

Statement of the Capabilities of Eyemouth Bay and Harbour for an Asylum Harbour.

Eyemouth, August, 1842.

ON the 12th and 13th July, 1842, a meeting was held in Edinburgh of the Scottish Convention of Royal Burghs. On the motion of the Commissioner from the burgh of Dunbar, a petition to the Admiralty, as well as to both Houses of Parliament, was resolved on, requesting that an engineer should be appointed to survey the port of Dunbar, so as to ascertain whether a Harbour of Refuge for coasting vessels could be formed there; and praying that, if the report was favourable, a grant of public money should be given to carry into effect that object.

In the information laid before the Convention to induce them to make this application to Government and the Legislature, no notice seems to have been taken of any other place than Dunbar, as deserving to be surveyed. At the same time, a description was given of the capabilities of that port for affording accommodation to trading vessels.

The petitions to the Admiralty and to both Houses of Parliament, which appear to have been adopted by the Convention, have not been published; but judging from what was said in recommendation of them, the following were the subjects sought for:—

1. That the port of Dunbar should be surveyed, to ascertain whether it was capable of being converted into a Harbour of Refuge, which would afford shelter to merchant and other vessels sailing along the coast.

2. That this survey shall be made by order, and at the expense of Government.

3. That if the report of the surveyors was favourable, a grant of public money should be given to form the proposed Harbour of Refuge.

If the petitions were so framed as to obtain only a survey of Dunbar, excluding all examination of any other place on the same part of the coast, it is proper, for the sake of the public service, that a survey so partial and local should not be agreed to. It is well known that there is at least one other port, viz. Eyemouth, about twenty miles south of Dunbar, which possesses far greater capabilities, and which certainly ought not, in any public survey to be overlooked.[*]

It is, indeed, matter of surprise, that the Convention of Royal Burghs, if truly desirous of seeing a Harbour of Refuge made which would be most serviceable, not to private interests, but to the public at large, should not have asked for a general survey of that part of the Scottish coast to which their regards were confined. Some of those who took part in framing and recommending the petitions which were adopted, could scarcely have been ignorant of the capabilities of Eyemouth bay, or of the petitions sent to Government a few years ago, pointing it out as a place where an excellent Asylum Harbour could be formed. If it were possible to suppose that the survey asked for by the Convention was confined to Dunbar, on purpose to exclude Eyemouth from the inspection of the Government engineers, lest it should be preferred, the circumstance would afford additional testimony to the merits of Eyemouth, and should be a reason for caution on the part of the Government and the Legislature in adopting the views of the petitioners.

But apart from the reasons which led to an application of so partial a public survey, it is proper to attend to the grounds on which this application was recommended. It implies, of course,—as indeed it was expressly and strongly stated by those who urged the application,—that at Dunbar there could be formed a good Asylum Harbour for the use of merchant and other vessels sailing along the coast, wherein they could at all times obtain safe and convenient shelter.

Now, in anything which follows, there is no desire to disparage the capabilities of Dunbar. But the proposition which is meant to be submitted to Government, and to the public generally, is this,—that if at Dunbar a good Asylum Harbour can be formed,—at Eyemouth one vastly superior can be formed, at no disproportionate cost of money.

This proposition rests on the following special grounds:—

1. That whilst at Dunbar the greatest depth in the Asylum Harbour proposed, there is not stated by Mr. Ritchie to be more than 1½ fathom,—at Eyemouth, the average depth of the outer half of an Asylum Harbour formed there would be, at low-water spring tides, 5 fathoms, and that of the inner half 2 or 3 fathoms.

2. That at Eyemouth the Asylum Harbour would be about 500 yards long by 400 wide; whilst at Dunbar the accommodation would not be nearly so great.

3. That at the part of the coast where Eyemouth is situated, there is much greater need of an Asylum Harbour for shipping, than at the mouth of the Firth of Forth.

In order to render more intelligible the capabilities of Eyemouth for the formation of an Asylum Harbour, there is prefixed, on a reduced scale, a copy of a plan made by Mr. Mitchell, the engineer of the Fishery Board, when he reported on the improvements of which he thought it susceptible.

From this plan it will be seen, that the bay is protected by a natural breakwater of rocks, called Hincar, Hurcar, and Briggs. On each side of this cluster of rocks, there is a passage into the bay, which passages are so deep as to allow a considerable swell to roll into the bay.

The proposal is to block up one of these passages, in order to convert the bay into an Asylum Harbour; and as the bay was most agitated by the swell which rolls in through the north entrance, it was recommended by Mr. Mitchell, and by every other person of experience or skill who has considered the subject, to block up that passage by an artificial breakwater.

1. The depth of water in every part of the bay is shown on the plan;—from which it appears that at all times of the tide, there are above 5 or 6 fathoms in the outer half of the bay, and above 2 to 4 fathoms in the inner half of the bay. This depth of water is sufficient for the largest class of merchant vessels and other coasters.

2. The capacity of the harbour which would thus be formed, can also be deduced from Mr. Mitchell's plan. From the Briggs rock towards the town, there is a distance of 520 yards, with a depth of from 2 to 5 fathoms; across the bay, from shore to shore, the distance varies from 300 to 430 yards.

Thus the capacity of the harbour would be about 200,000 square yards. Now, allowing that each vessel would be, on an average, 90 feet long by 20 feet wide, or occupying about 200 square yards of space, and that each vessel would require about four times more than its own space for swinging and wharfage, &c. there would be accommodation for about 200 vessels, of which there might be fifty drawing more than 15 feet of water.

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[*] A detailed survey of Eyemouth harbour and bay had been completed by the Admiralty surveyors in 1839; no Government survey of Dunbar bay has yet been made.—Ed.

APPENDIX C.

EYEMOUTH.

No. 56.
Statement of the Capabilities of Eyemouth Bay and Harbour for an Asylum Harbour.

3. In regard to the greater necessity of an asylum harbour in that part of the coast where Eyemouth is situated than at Dunbar, no one can have any hesitation who but looks at a map of the coast.

The chief danger to coasting vessels arises during easterly gales, with a lee shore presenting no haven of safety. Now, vessels suffering under an easterly gale have a much better chance of clearing the land near the Firth of Forth, than between St. Abb's Head and the Fern Islands. In the former case they have the mouth of the Firth to stretch across and fetch off the land; and if they cannot do so, they have only to run up the Firth with a fair wind to Aberlady Bay, or behind Inchkeith,—at either of which places they ride in safety. But a vessel near the shore, between St. Abb's Head and the Fern Islands, has neither of these chances of escape, and, on the contrary, has a worse kind of shore to clear. The coast there forms a sort of crescent, of which the horns are the two points just named; and it is especially difficult for any vessel near Berkwith or Eyemouth to clear the land in these circumstances. It is obvious, therefore, that the coast is much more dangerous to trading vessels at or near Eyemouth than at or near Dunbar, so that an Asylum Harbour would be more valuable at the former place than at the latter.

4. There is another consideration, though of minor importance, which ought not to be overlooked.

The fishery trade is now becoming important in a national point of view, and deserves to be attended to as well as the shipping interest.

It is scarcely necessary to say that an Asylum Harbour would he extremely serviceable to the fishing-boats frequenting the coasts, especially during the season of the herring fishery, when, from the want of any near harbour which can be taken at all times of the tide, boats are frequently swamped, and valuable lives lost.

Now, at Eyemouth there is a very extensive fishery trade carried on, comprehending not merely herrings, but also cod, turbot, and haddocks. The extent to which the fishings of herrings and cod are carried on may be judged of from the returns made to the Fishery Board, which will be found in the Appendix; and these returns shew also that the fishery trade is carried on much more extensively at Eyemouth than at Dunbar, or, indeed, almost any of the other ports along this part of the coast.

If, therefore, the number of boats and lives, and the amount of property engaged in the fisheries, be greater at Eyemouth than at Dunbar, surely this circumstance affords an additional reason for forming there an Asylum Harbour, which will afford shelter in stormy weather. The present harbour of Eyemouth is dry for some hours about the time of low water, so that it is only during a certain portion of the tides that the harbour affords shelter; and, moreover, the number of boats which frequent the port during the herring season are so great, that, when there is much shipping in it, it does not afford proper accommodation, even when accessible.

Those engaged in the fisheries at the mouth of the Firth of Forth are not exposed to the same risks and inconvenience. There is a much greater number of small harbours along that part of the coast, than at or near Eyemouth; so that there are even now greater facilities for carrying on the sea fisheries at and near Dunbar, than along the coast to the south: and when the new harbour forming at Dunbar is completed, it will (as is said) be occessible at all times of the tide. Even assuming, therefore, that the trade at Eyemouth is not greater than at Dunbar, it is but fair that some aid from the public funds should be given to the fishermen at the former place, as well as at the latter. Mr. Ritchie states that Government (by which he probably means the Fishery Board) has already advanced 7000*l.* in order to form a new Fishery Harbour there; and it is understood that an additional sum of 1000*l.* is to be granted by the same board. Besides all this, new claims are made on the public purse still further to enlarge Dunbar harbour. But if the public money is to be applied to such purposes, it would surely be proper to give a supply, in the first instance, to a port which has never received a shilling either from the Fishery Board or the Government, which is frequented by at least as many boats and vessels as Dunbar, and where there is a far greater want of shelter.

These considerations are now humbly submitted to Government and to the public, with a view not to decry or undervalue Dunbar as a useful fishing station,—not to exaggerate the capabilities of Eyemouth bay for an Asylum Harbour, but simply to shew that Eyemouth ought to be included in any survey which Government may institute with the view of ascertaining the most proper site for an Asylum Harbour on this part of the Scotch coast.

It is proper also, that the present Government should be made aware of the representations which, on this very subject were made to their predecessors in office a few years ago by the shipping interests connected with this part of Scotland. Some of the petitions which were then sent to the different Executive Boards in London are printed in the Appendix, from which it will be seen that a general survey of the whole coast was prayed for. This was the fair and impartial course to follow if the public interests are to be alone regarded.

Some other documents have been inserted in the Appendix, showing the opinion entertained by men of professional skill and nautical experience, as to the capabilities of Eyemouth Bay and the advantages which would result from the establishment of an asylum harbour there. It has been thought right to publish these, in order that the public may see that Dunbar is not the only place on the east coast of Scotland where "a complete harbour for merchant vessels" may be formed.

There is only one point—most material,—on which the documents now published afford little or no information,—What would be the *expense* of converting Eyemouth bay into a Harbour of Refuge? Mr. Mitchell, in his Report, gives a rough estimate at 46,000*l.*, observing, at the same time, that he can form no definite opinion on the subject, without further information. On the other hand, it is stated in one of the Petitions printed in the Appendix, that the cost would not exceed 20,000*l.*—a statement which it is understood was made on the authority of Mr James Jardine, civil engineer. The Floating Breakwater Company fix their highest estimate at 17,000*l.* From these various statements, little certain information can be drawn. But the probability is, that for less than 50,000*l.* a secure and safe harbour could be formed on a dangerous part of the coast capable of holding 200 vessels of all sizes; and when it is considered that no other place of shelter exists towards the north nearer than Aberlady bay or Inchkeith in the Firth of Forth, and towards the south, nearer than the Humber, about 150 miles distant, such a sum is not too much for so great an object. The asylum harbour proposed to be formed at Redcar on the Yorkshire coast, was estimated to require an expenditure of 350,000*l.*

APPENDIX C.

EYEMOUTH.

No. 57.
Return of Income and Expenditure.

No. 57.

Return of Income and Expenditure.

Income.	1841.			1842.			1843.			Expenditure.	1841.			1842.			1843.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Harbour dues	217	14	7¼	190	15	5¼	206	7	5	Clerk's salary . .	8	0	0	8	0	0	8	0	0
Ballast rent	6	7	6	4	13	0	2	12	3	Harbour master's salary . . .	10	6	8	12	16	9	10	13	2¼
Steelyard .	0	16	8	..			0	16	3	Officer's salary .	0	12	0	0	12	0	0	12	0
Interest on Account Current.	6	11	5	..			7	6	6	Inspectors salary	..			..			38	10	0
										Rent of office . .	1	10	0	1	10	0	0	0	0
										Sundries for repairs	64	14	8	151	14	3	34	17	4
Subscription from boats for light .	..			2	5	6	..			Miscellanies . .	1	10	1	7	14	8	21	13	3
										Interest on borrowed money .	25	0	0	..			22	10	0
										Building jetty and rebuilding old quay . . .	1000	0	0	..			..		
										Enlargement of quay . . .	..			..			..		
Total . £	231	10	2¼	107	13	11½	217	2	5	£	1117	13	5	177	7	6¾	136	15	9¼

Amount of debt to 31st December, 1845, 2200*l.*

Examined December 21, 1844.

THOMAS BOWHILL, *Treasurer.*

BERWICK-UPON-TWEED.

No. 58.

Examining Commissioner, Captain WASHINGTON, R.N., F.R.S.

Evidence taken on the 7th October, 1846.

Present:—The Mayor; the Sheriff (Captain SMITH, R.N.); Captain HAY and Lieutenant GUTZMER, of the Coast Guard; THOMAS GILCHRIST, Esq., Town Clerk; WILLIAM WILLOBY, Clerk to the Magistrates; Dr. CLARK (J. P.); Dr. JOHNSON (J. P.); ROBERT WEDDELL, Solicitor; EDWARD WILLOBY, Solicitor. R. B WEATHERHEAD, Solicitor; Mr. ROBERTSON, of the firm of ROBERTSON & Co., Iron Founders; Mr. GUTHRIE, late Iron Founder; Mr. GOWAN, Shipbuilder; Mr. CROSSMAN, Merchant; Mr. CHISHOLM, Merchant; Mr. SINCLAIR, Agent to Lloyd's; Mr. CLEMENT PATTISON, Clerk to the Commissioners; Mr. THOMPSON, Harbour Master; Masters of Vessels—JOHN THOMPSON, JAMES THOMPSON, and JOHN LINDSAY; Pilots—JAMES WOOD and RALPH DIXON; — SWINNOE, Pilot on board the Revenue Cutter; J. M. DICKSON, Esq., (J. P.,) GEORGE GILCHRIST, Esq., (J. P.,) and GEORGE K. NICHOLSON, Esq., (J. P.,) three of the Commissioners of the Harbour; the Reporters for the Berwick and Kelso Warder, and Berwick Advertiser; several mariners, &c.

The COMMISSIONER opened the proceedings by reading the Royal Commission. He then stated that this was an inquiry into the past and present state of the harbour of Berwick, and its capabilities for further improvement;—that it was a public meeting, and that he invited the remarks and suggestions of any pilot, mariner, or other person interested in the welfare of the port. He said that in company with the Chairman and the Harbour Master he had at low water that morning walked round the harbour and made a personal inspection of the condition of the pier and quays, and that he now requested the evidence of those conversant with the harbour for many years,—as in harbour improvements there was nothing to be done without the benefit of local experience.

Mr. PATTISON examined.—Had been Clerk to the Harbour Trust since 1812. Previous to 1808 the harbour was in the possession of the corporation. At that date it was resigned into the hands of Commissioners appointed by Act of Parliament, at which time the building of the present pier was commenced agreeably to the recommendations of Mr. Rennie, and from a plan furnished by him from a survey made by Mr. Blackadder. The Charter of the town dated from the reign of King James in 1600; the dues levied under its authority went to the common fund, the quays on the north side of the river were built by the corporation. An old pier, called King Edward VI. or Queen Elizabeth's pier was the foundation of the present erection. The original number of Commissioners was eighteen, the present number of these was fifteen; three of these lived at a distance, and were *de facto* no longer Commissioners. None of them had been sailors. Never heard any complaints of the constitution of the Board, which gave its services gratuitously. Meet once a month at least, and oftener when emergency requires. A minute book of the proceedings is kept. Not much business before the board for the last three months. One or two persons have made complaints of the want of accommodation, both verbally and by writing. On the 22nd February, 1845, a memorial was received from shipowners and others for the erection of a breakwater. Petitioners were answered on the 27th March, to the effect that until a report was received from Mr. Moor, their engineer, the Commissioners deferred the consideration of the petition.

The COMMISSIONER having turned over the minutes of meetings succeeding the above date, and finding no entry of the reply sent to the petitioners, remarked on the omission. The minute book, by Act of Parliament, was ordered to be received as evidence in a court of law, and here was an omission of a very important event, he feared therefore its value in that respect was destroyed.

Mr. PATTISON.—On the 2nd April last a memorial was presented from inhabitants of Tweedmouth, soliciting the erection of a wharf on the south side of the river. It was considered advisable not to grant the application, as there was no surplus fund; besides, the Commissioners wished to ascertain the effect the railways would have upon their revenue before they incurred more debt. The act empowered the Commissioners to borrow money for the purposes of the harbour, whatever sums were necessary. There was no limit. In 1817 the Commissioners were indebted to the Exchequer Loan Office, 20,000*l.*, which had been gradually reduced, and the balance now due was 1,350*l.* The Commissioners were empowered by the 44th clause of their Act to examine and license pilots. Never heard any complaints respecting the appointments made. The conduct of one or two pilots has been complained of, and some of them have been suspended. The harbour extended from the bridge to the sea, and from the pier two miles in every direction. There is a schedule of dues. The shore dues are levied to their full extent. The Act prohibits their reduction. The tonnage dues are at present only levied to one-fourth of the sum mentioned in the Act. In 1834 these were taken off altogether. Renewed again in 1837 to meet the expenses of dredging and other improvements.

Mr. THOMPSON.—Had been treasurer and harbour master since 1808. [Produced the office-books.] There had been a very great increase in the revenue of the harbour during the last twenty years. From July 1810, to July 1811, the shore dues inwards amounted to 623*l.*; the same dues from July 1845, to July 1846, amounted to 1,316*l.* In 1810 the total revenue was 2,545*l.*; the total revenue last year was 3,239*l.* At present the tonnage dues are only a fourth of their amount at the former period. The maximum revenue was in 1816, namely, 3,579*l.* The dues have been lightened, and the revenue of the port has been kept up. Since the passing of their Act the Commissioners have erected the light-house on the pier. No charges are made for it. Its cost is defrayed out of the harbour dues. The debt of the harbour is 1,350*l.* due to the Exchequer Loan Office, and 9,000*l.* to private individuals. The half of the debt due to the Exchequer will be paid off this month, the remainder in October, 1847. At present he has on hand a surplus of 1,818*l.*, which reduces the real debt to 8,531*l.* Some difficulty was experienced lately in raising the money required on bond of the harbour dues, when the Commissioners came forward and became personally responsible. Interest is paid at the rate of four per cent. The annual statement of account in the form rendered to the town council was submitted.

The COMMISSIONER made several remarks as to the want of explicitness in the accounts. So far from affording the fullest information, the mode of stating them seemed calculated to give as little as

Appendix C.

Berwick.

No. 58.
Evidence taken on the 7th October, 1846.

possible. He recommended that the expenditure should be classed under separate heads, as salaries, new work, repairs, dredging &c.; and said that he felt it his duty to remind the Trustees that they were administering a public trust, and that their accounts therefore should be so made out as to be intelligible to the public.

Mr. **Thompson**.—The receipts are placed in the bank, and when the surplus over the expenditure amounts to 1,000*l.*, debt to that amount is paid off.

The **Commissioner** remarked he was glad to hear so favourable an account of the business of the harbour. As far as a cursory inspection would enable him to judge, the treasurer's books were in good order. With the exception stated above, all appeared correct.

Mr. **Thompson** continued.—He was also harbour master. There was no resident engineer. One was engaged when his services were required. Recollected the commencement of the pier, and surveys and reports being obtained from Mr. Rennie and Mr. Blackadder. Mr. Fox was the resident engineer. The pier is upright; was completed in 1822, and cost about 72,000*l.* Its entire length is 2,500 feet. It is founded on rock and on piles. Is built of sandstone procured at Hudshead. The foundations are not deep. Some of them are to be seen at low water. Have given way at several places and at different times, and they would not admit of deepening the harbour another foot without being secured.

The **Commissioner** remarked that this was truly to be regretted after so large an outlay as 72,000*l.*, but he was compelled in justice to admit that it was no more than had occurred to many other piers on the coast.

Mr. **Pattison** stated that great opposition was experienced from the owners of fisheries on the building of the pier, which had cost the Commissioners a great deal of money, and had prevented a great public work from going on, so much so that a gap of 80 feet in extent had been left, and only closed after considerable delay. The repairs lately given to the pier have been well done. Some of the stones placed thereon are 3 and others 4 tons weight—17 feet to the ton. The parapet wall was too light, and the sea washed stones of 1½ tons weight into the river, but it has stood well since these larger stones were put there. There are now stones loose in the face of the pier, which required immediate repair. Several stones are washed out. Mr. Moor was called on to make a report and give an estimate a year ago, but nothing has been done.

Mr. **Thompson's** opinion was that no repairs would be required for five years.

The **Commissioner** thought, from what he had seen that morning, in walking to the end of the pier, that, if repairs were deferred so long, the Harbour Commissioners would find it a mistake.

[A long discussion ensued respecting the formation of docks and other improvements contemplated some years ago, and Mr. Rhodes's and Mr. Cubitt's reports thereon. These alterations were estimated by Mr. Rhodes to occasion an outlay of 120,000*l.*, and the difficulty of procuring this sum caused the scheme to be abandoned. This was in 1838.]

Mr. **Pattison**.—The pier end was fortified in 1844 to protect the light-house. Is of opinion that the pier is placed in the best direction. The light-house was built in 1826. It showed a fixed light and a tidal light, when there was a depth of 10 feet water over the bar. The quay on Carr Rock was built in 1836, and the road, 2,500 feet long, made from thence to the pier. The dock was two-thirds re-made, and the quay near the bridge rebuilt at an expense of 600*l.* The steam-boat jetties were built in 1838, and had 3 feet water alongside them at low water springs. The bed of the river is gravel, and there is a hole 10 feet deep on the north side, scoured by the rush of the water through the bridge. The bridge has fifteen arches, and the piers are defended by starlings. Is of opinion these do no harm. The tide flows eight miles above the bridge as far as Norham Castle; freshes cause much damage, occasionally bringing down trees and stones into the harbour. In 1831 an extraordinary fresh, with ice, blocked up the entrance and opened another. So much damage was done, that Mr. Rhodes, who was consulted, recommended a pier on the south side. A pier was prepared for the ballast quay. The Harbour Commissioners deliberated respecting it, but fishing rights would have interfered. A dock was proposed, but negatived.

Mr. **Thompson** resumed.—The dredging machine had been of great use. It had deepened the river 4 feet 6 inches from the bridge to the sea. With its barges and apparatus it cost 4,616*l.* From forty to fifty vessels lie in the river. No damage occurs to vessels alongside the quays. There are sixty vessels belonging to the port. The S.E. is the most exposed quarter, and that wind causes much swell. Steamers of 500 tons ply to London. No wrecks take place. The bar is of rock, and might be removed.

The **Commissioner** enquired whether any endeavour had been made to reduce the bar, and being informed there had not, remarked that it was in a great measure in vain to proceed with internal improvements while they kept the door closed. Having signified that he had gone through his routine of inquiries, he stated if any person present wished to make any remarks he was prepared to hear him.

Mr. **Robertson**, of Tweedmouth, after remarking that he had been informed of this meeting only half an hour ago, and consequently was ill prepared to state concisely his opinions on the state of the harbour, proceeded to call the attention of the Commissioner to the memorial presented by the inhabitants of Tweedmouth for wharf accommodation on the south side of the river. The memorial was produced, also the reply of the Commissioners. (*See* Appendix, No. 70.) The latter assigned as their reason for non-compliance with the request the want of funds, and the wish to ascertain the effect the railways would have on the harbour receipts.

The **Commissioner** said he would take charge of the memorial, and it would receive consideration elsewhere.

Mr. **Robertson** said the memorialists would be content with a timber or open pile erection, so that they might be able to discharge their vessels at all states of the tides.

Captain **Hay**, R.N.—Inspecting Commander of this district and harbour; acquainted with Berwick for ten years. In his opinion, a landing place is wanted on the South side. The sea has been making serious inroads lately on the north side of the harbour; thinks the best remedy would be the erection of a breakwater to extend out into the river from Coxon's Tower, which would break the heavy swell that now rolls in over the Spittal Point in easterly gales, and prevent the damage done to shipping, which can scarcely be held at their moorings. In proof the following letter was read:—

Sir, *Berwick-upon-Tweed, October* 7, 1846.

I conceive it to be my duty to acknowledge the kind assistance afforded me by one of your preventive men, without whose aid, I have every reason to believe, my sloop would have been lost entirely owing to the want of protection at the ballast quay, where the surge is so heavy, that no vessel

APPENDIX C.

BERWICK.

No. 58.

Evidence taken on the 7th October, 1846.

can lie there in safety. A memorial was some time ago sent to the Harbour Commissioners, praying that a breakwater might be erected near Coxon's Tower, which the masters trading to the port are unanimously of opinion would have the desired effect of breaking the surge, and protecting the shipping. The Commissioners were advised by Mr. Moor, that the surge did not run in the direction of the quay and along the shore, and they therefore refused the application. Experience has proved the injury I and others have sustained from the contrary, I therefore humbly crave that you will be pleased to represent this grievance to the Tidal Harbours Commissioners, who are to be here to-morrow.

I am, &c.,

JOHN CHISHOLM.

To Captain Hay, R.N., Inspecting Commander.

Mr. GOWAN and Mr. CHISHOLM were of opinion, that such a breakwater is required to still the water in the harbour and to shelter a portion of the beach where vessels may be laid ashore to be repaired.

[A report was read from Mr. Moor, the late engineer, whose opinion was opposed to such a breakwater for reasons assigned, and proposing instead, the extension of the ballast quay, for 280 feet. (*See* Appendix No. 69.)]

JAMES SWINHOE is a native of Berwick; has been a pilot for twenty years, and is now pilot on board the revenue cutter on this station. In favour of a breakwater. The swell comes over Spittal Point very heavily in easterly gales, and brings much sand with it. Eleven years ago he lay afloat in a cutter drawing 13 feet water, where there are not 6 feet now. Over the bar there is full as much water as there was formerly.

JAMES WOOD has been a branch pilot for fifteen years; there is the same water over the bar as formerly, but more inside the pier, where the dredging has done much good, by removing the ford, and enabling vessels to get up to the quays. There is still much loose sand inside the pier-head. The range of the swell alongside the quays is very great, and is of opinion that the breakwater proposed from Coxon's Tower would be a benefit, if not carried out too far. There are twelve pilots for the port, and they can gain a tolerable livelihood. The wrecks he remembers are, the *Atlas*, at the back of the pier; a Dutch vessel on the bar in 1835; and the *Cupidon*, on Spittal Point, in 1838. Does not think the Shad is lower than formerly. Cannot come up now with a boat.

Mr. SINCLAIR, Lloyd's Agent, said that the insurance companies were satisfied with the river and the entrance. Complaints certainly were made of the range of swell at the quays. Risks were taken here as cheap as elsewhere.

JOHN LINDSAY, shipowner and shipmaster for thirty years, was of opinion that a breakwater is wanted from Coxon's Tower; the sea has so encroached them about, that the road round by that tower is wasted away. The Shad is certainly higher than formerly. Can remember when pilot boats used to cut across it, which they cannot do now.

JAMES THOMPSON, master mariner, states that the range at the quays causes great inconvenience, and sometimes damage. Thinks that a breakwater at Spittal Point is wanted.

[The Harbour Commissioners' objection to a breakwater from Coxon's Tower was, that it would have the effect of further diverting the stream of the river to the south, and thus endanger the permanency of Spittal Point.]

The COMMISSIONER said, as far as a cursory inspection of the plans would enable him to judge, such an erection, if not extended too far into the river, would not occasion the injury apprehended, and might effect the good devised; but he would recommend the Commissioners to take the subject into their serious consideration at once, and carry out whatever was agreed upon as the best plan. The breakwater might be extended gradually, and the effect of it carefully watched; by this mode of proceeding, no great damage could arise. It was not the time of day to stand still and do nothing.

JAMES WOOD, on being asked if he could suggest any improvements to the harbour, remarked that what appeared the first want, in his line, was some signal which could be given to vessels in coarse weather, to intimate the depth of water on the bar, and when the pilots could not go out to them. He recommended a flagstaff on the light-house. During night, notice was given of 10 feet water being on the bar by the tidal light, but during the day no signal was given.

The COMMISSIONER approved of the suggestion, and trusted that no time would be lost in carrying it into effect. He was sure the Harbour Trustees would see the advantage of it.

Mr. DICKSON, on behalf of the Harbour Commissioners, intimated that this recommendation should receive their earliest consideration. [The flagstaff has since been erected.]

The COMMISSIONER enquired whether any life-boat was in the harbour.

Captain HAY said that eleven years ago the inhabitants of this town and neighbourhood had, by voluntary subscriptions, raised 300*l.* for the purpose of a life-boat. When the boat first arrived, through the unskilful treatment of the gentleman who took the charge of it, the public lost all confidence in its safety, and no one would sail in it. It had therefore been laid up for several years; but he had been informed the other day that it was in good repair.

Mr. WEATHERHEAD remarked that some person had fired a pistol shot through the door of its storehouse, which had perforated the hull of the boat.

The COMMISSIONER was surprised to hear this latter statement. That such wantonness should be found on the sea coast, was perfectly astonishing.

Mr. ROBERTSON renewed the discussion on the statement of accounts, by handing to the Commissioner the opinion of counsel lately procured by the borough town council, on the subject of their power to enforce the production of a more explicit and detailed statement. Mr. Robertson said the statement annually produced to the council was nothing short of a burlesque, as it was drawn up in such a manner, and contained so little information as to defy any person to gain knowledge from it. The council made application for a fuller account, and was refused it, upon which counsel's opinion was obtained, and that being adverse to the enforcing of a fuller statement, the matter was dropped.

The COMMISSIONER said he had already expressed himself regarding that account to the effect that it was impossible for any stranger to understand it, or to ascertain by it how the affairs of the harbour stood. The Act of Parliament ordered a statement of accounts to be annually produced, and that clearly implied such a statement as was intelligible.

APPENDIX C.

BERWICK.

No. 58.
Evidence taken on the 7th October, 1846.

Mr. **ROBERTSON** said the request for a fuller statement originated in the desire for a revision of the schedule of dues. These continued as originally fixed in 1808, and when it was remembered that many changes in business and in goods had occurred since that period, the inequality of many of these charges would be apparent.

Mr. **DICKSON** remarked that a great difficulty in getting the different trades to agree as to the changes would be experienced.

Mr. **CROSSMAN** observed that he was one of the oldest tradesmen in the town, and he was not aware of any general dissatisfaction with the charges in the schedule. No meeting of tradesmen had been held on the subject, and the dissatisfaction, he believed, was merely individual.

The **COMMISSIONER** found the difficulty alluded to by Mr. Dickson to exist at all ports, but he hoped the Harbour Commissioners would give the subject their consideration.

[Some inquiries followed respecting the value of the fisheries on the Tweed, and whether the proprietors of these were found to oppose improvements to the harbour. The answers elicited were to the effect that the rental of the fisheries was somewhere about 8,000*l*;—that instances of opposition to improvements had been experienced.]

Mr. **WEDDELL** said, that observing that the Commissioner was anxious to know the date of the first pier, he had much pleasure in furnishing him with the following notes:—

From MS. Harl., 7017, *Art.* 38, (*British Museum*).

"*A discription of Berwick.*— · · · · It hath had a goodly peere, containing about 240 yards in length; but envious time, y^e deuourer of all things, hath decayed it."

This MS. was probably written in the reign of Charles I.

Sadler's State Papers, vol. i. pp. 389, 390.

In August, 1559, 1st Elizabeth, the Queen ordered Sir Ralph Sadler to go to Berwick. The following is a copy of part of his instructions:—

"Item, From thens he shall go to Berwyke, and there take a view of the fortifications and works, and procure at Sir Richard Lee's hands, and with the treasurers or otherwise, if it may then conveniently be done, the total charge, though it be but in an estimate of the fortification of the new PERE and fort that was began in *King Edward's* time and since relinquished."

In the Cottonian Library, (British Museum,) Aug. 1, vol. ii, p. 14, is "A highly finished plan of Berwick-upon-Tweed." The title is "The true description of Her Majesties towne of Berwick." It appears to be the workmanship of a foreign artist, and was probably drawn soon after the new fortifications were finished by Queen Elizabeth. It contains a plan of the *pier*.

Among "the State Papers" are full accounts of the new fortifications by Elizabeth, and I think it probable that they may also contain an account of the completion of *Edward VI.'s* pier.

Berwick, October 8, 1846. R. WEDDELL.

No. 59.
Return to an Order of the House of Commons, of the 9th August, 1844.

No. 59.

Return to Order of the House of Commons, of the 9th August, 1844.

SIR,

Berwick, March 1, 1845.

BY the directions of the Berwick Harbour Commissioners, acting under an Act, intituled "An Act for rebuilding the Pier, and for improving the Harbour of Berwick-upon-Tweed," I beg leave to intimate that I have, according to your directions, by this day's mail, forwarded to you copies of all the reports and plans in the Commissioners' possession, except one, the original being sent. I have marked in the margin of each report, in red ink, the several works recommended, and what have been executed.

A little delay has been occasioned in forwarding the plans by the miscarriage of the parcel from the Exchequer Loan Office, but it is hoped that the delay will not have caused any inconvenience.

I have, &c.,

To the Hon. Manners Sutton. CLEM. PATTISON, *Clerk to the Commissioners.*

List of Plans and Reports.

Report 1.—Mr. Rennie's Report	. . .	Dated February 9, 1807.
Plan 1.—Plan by Mr. Blackadder	.	Ditto.
,, 2.—Mr. Rhodes's Report	. . .	,, July 25, 1835.
Plan 2.—Plan, with red lines	. .	Ditto.
,, 3.—Elevations of Plans of Jetties, No. 2		Ditto.
,, 3.—Mr. Rhodes' Report	. . .	,, February 25, 1836.
Plan 4.—See Plan of this date	. .	Ditto.
,, 4.—Mr. Cubitt's Report	. . .	,, January 21, 1837
Plan 5.—Plan by Mr. Blackadder.	Original sent,	May, 1837.
,, 5.—Mr. Rhodes's Report	. . .	Dated January 13, 1838.
,, 6.—Mr. Rhodes's Report	. . .	,, September 14, 1838.
Plan 6—Plan	. . . .	,, August 11, 1838.
,, 7.—Mr. Rhodes's Report	. . .	,, September 27, 1838.

In all seven reports and six plans.

No. 60.

Report on the Harbour of Berwick-upon-Tweed, by JOHN RENNIE, Esq.

London, February 9, 1807.

APPENDIX C.

BERWICK.

No 60.
Rennie, on the erection of a Pier.

Few places are better situated for trade than the town of Berwick-upon-Tweed. The interior country is fertile, the Tweed abounds in salmon, and there is no place near which can at all come in competition with it, except Eyemouth; but here the harbour is small and the water shallow. Berwick may therefore be said exclusively to possess an extensive and fertile tract of back country that can have no other convenient and cheap means of exporting its produce, or importing such articles as are required, but through this harbour. It is therefore rather extraordinary that a town with such a population as Berwick, situated on so fine a river, and with so fertile a country behind, should have no better harbour than is now here.

In former times, when England and Scotland were separate nations, Berwick was a place of great importance as a military station, and was probably also a place of considerable trade.

In the reign of Queen Elizabeth it is said that a pier was built on the Beacon Rock, the foundation of which I traced for a considerable extent, but the pier itself is almost entirely demolished. When that pier was in existence the harbour was said to be good, and that its decay kept pace with the decay of the pier; be that as it may, the harbour at present is in a very bad state, both in regard to depth of water and exposure; something therefore is greatly wanted to shelter the harbour and to enable vessels to enter into or go out more expeditiously and safely than they now do.

The river Tweed is probably *the third*, if not the SECOND in *point of size of any in Scotland*. Its course is along the tract of country which drains into it, is high and extensive; in heavy rains, therefore, the floods are large, and were its course properly directed at its entrance into the sea below Berwick, a depth of water would thereby be obtained sufficient *for the largest merchant ships that are likely to frequent those seas*; but while it is allowed to meander among the sands as it now does, and its course at the entrance obstructed or turned in different directions when water is short in the river according as the storms prevail, it cannot therefore be expected that either the channel should be regular or the water deep, until the river is confined by artificial means, and sheltered from the effects of storms that tend to change its course.

The pier built in the reign of Queen Elizabeth, so far as I could trace it, seemed to be placed in as good a direction as it well could be to shelter the harbour from storms with north-easterly winds, but it is quite exposed to those which come from the southward of east, as the entrance lies in a direction east south-east and west north-west, the greatest swell within the harbour is with east and south-easterly winds.

Northerly winds occasion the heaviest swell on the bar, but it does not run far up the harbour. The most hazardous situation vessels can be in, is when entering or going out of the harbour; the wind therefore that occasions the greatest swell at the entrance is that which is most to be guarded against; and as the north-easterly winds occasion the heaviest swell on the bar, I advise that a pier be built from the extremity of the Beacon Rock, along the rock quite to Crabwater, and from thence return to the heights of Magdalen Fields, as represented by the letters L. M. N. on the plan.

This pier will completely shelter the entrance from north-easterly winds, and will render the water more smooth on the bar; but when storms come from south-easterly points no shelter will be afforded by this means. As, however, the tide flowing into the harbour, and ebbing out of it, together with the water and floods of the Tweed will, by this pier be confined to one regular channel, it will be scoured out and widened, so as to give more room for vessels to work into and out of the harbour than they now have. But, as I am informed, that the bottom under the sand is rock, no great additional depth can be expected; this, for the usual class of vessels that frequent the port of Berwick is not necessary, there being depth enough already. Spring tides usually rise from 14 to 15 feet; neaps from 8 to 9 feet.

At the high water of an ordinary spring tide, there is from 19 to 20 feet of depth on the bar, 24 to 25 at outwater on the stell, 20 to 21 feet near Spittal, and from 13 to 15 feet at the quay at Berwick, and this will not be at all affected by the proposed pier.

Nothing can be effectually done to deepen this upper part of the harbour, unless the channel is contracted so as to confine the floods into a narrow compass; they will thereby scour the bottom deeper; this might be done to great advantage opposite the quay, and from thence to the Carr Rock, were it not for the salmon fishery, which, although I am not inclined to think any material injury would arise in contracting the river, yet I fear those interested in the fishery would object to any material contraction above Spittal; and if no contraction can be allowed, all I can advise is, to remove all obstructions from the sides and bottom of the river that can without prejudice to the salmon fishery be done; and by having one or two machines to take up ballast for the use of shipping in the river, I am persuaded that in a short time, the additional depth of a foot or 18 inches may be obtained which will be of great consequence to the trade.

The quay wall abreast of the town is in many places in a very bad state, and no convenient dock or inlet any where upon it for shelter during ice, floods, or storms of south easterly winds; something, therefore, ought to be done in this way, and such walls as are built should form a regular sweep, so as not to interrupt the course of the river; and if the foundations are laid deep, and the channel well ballasted, I have no doubt there will soon be 16 or 16½ feet of water in spring tides, clear along the town quay.

By a pier on the north side of the channel at the Beacon Rock, the water will, as I have before said, be confined into one channel, which is not the case at present, and consequently the channel will be increased in width and depth.

The sandstell will be shortened, as well as the shifting sand to the eastward; but although by this means the entrance for vessels will be greatly improved, yet I fear a heavier swell will be thrown up the harbour; and thereby may render the berths of vessels lying at the quay more uneasy, and of course less safe, than they now are.

Should this prove to be the case in any considerable degree, a wooden pier or breakwater may be made from the Green Shore or point just below Spittal, towards the north, having its head lying in such a direction as to give a turn to the in-run of the sea at the entrance, and prevent it from rendering the berths of vessels at the quay unsafe; or perhaps, a short jetty, built from the rampart wall of the fortification, to turn the force of the sea towards Tweedmouth, might answer the purpose,—but I would greatly prefer the former.

APPENDIX C.

BERWICK.

No. 60.
Rennie, on the erection of a Pier.

Powers should be obtained in the Act of Parliament to enable the mayor and burgesses of Berwick, to erect whichever shall be found most eligible on trial, after the north pier is finished; but I have no doubt that from Spittal Point will, under all circumstances, be preferred, if any is wanted at all.

The pier proposed to be erected on the Beacon Rock, should have proper capsterns and posts upon it, to make fast the lines to heave vessels in or out as may be required; and a small light should be placed on the pier head for the use of the vessels at night. A warping buoy should also be laid just without the bar, to enable vessels to warp out in moderate weather, and this should be done with as little delay as possible.

I have estimated the expense of the pier on the Beacon Rock, with the return, at 27,000*l.*, which I think will fully cover the expense, having kept the prices very high.

This estimate is made on the supposition that stones are got in part from the hill face just above the bridge, and in part from the quarries on the south side near to the Carr Rock; probably some may be got from the northward, when the weather is fine; but I do not think much dependance may be placed on any stone that is to be brought coastwise.

The plan I have described seems to me to interfere in no respect with the fishery; the fishermen will be left in possession of every thing they now enjoy, except the two stells, the Dun Cow, and that above. These I propose to remove, as injurious to the harbour.

The Gut will also be stopped up, so that the pilots will not be able to go out in that direction, this will no doubt be some inconvenience to them, but that is nothing when put in competition with the injury it does to the harbour.

A boat harbour may be made under the cliff to the north, as very sensibly proposed by a member of the corporation, and from thence they can go out when it suits them.

I am, therefore, decidedly of opinion, that no injury will by this plan be sustained by any class of people.

Estimate of the Expense of a Pier proposed to be built on the Beacon Rock at Berwick-upon-Tweed.

	£	s.	d.
To 2,600 cubic yards of large rubble foundation at the outer end of the pier, at 7*s.*	1,260	0	0
To 15,466 cubic yards of masonry in the two walls of the pier on the Beacon Rock, being 640 yards in length, to be built of large Ashlar stones, at 15*s.* . .	11 599	10	0
To 23,790 cubic yards of filling, with rubble and gravel between the walls, at 4*s.* .	4,758	0	0
To 1,300 cubic yards of parapet, to be done entirely with cut stone, at 18*s* . .	1,170	0	0
To 4,082 square yards of carriage paving, at 3*s.* 6*d.*	714	7	0
To 3,878 cubic yards of Ashlar masonry in the two walls of the return pier, at 12*s.* .	2,326	16	0
To 310 run yards of filling, with rubble and gravel between the walls, at 3*s.* 6*d.* .	883	10	0
To 1,395 square yards of carriage paving, at 3*s.* 6*d.*	294	0	6
To 515 cubic yards of parapet, to be done entirely with cut stone, at 18*s.* . .	463	10	0
To iron bars in the pier, utensils, and incidental expenses . . .	3,530	6	6
	£27,000	0	0

JOHN RENNIE.

No. 61.
Rhodes, on the Harbour of Berwick.

No. 61.

First Report on the Harbour of Berwick-upon-Tweed, by THOMAS RHODES, Esq.

SIR,

York, July 25, 1835.

IN compliance with your letter of the 2nd June last, wishing me to examine and report, for the information of the Commissioners, respecting the state of the harbour of Berwick, I proceeded thither on the 27th ult. During my investigation of several days on this subject, with the information derived from yourself and several of the Commissioners who accompanied me over the works, I find that the river has changed its course very much of late years at the mouth of the harbour, and made considerable encroachments on the south-east bank, near the village of Spittal.

This bank being of a loose sandy nature, and the current setting down its concave side with great velocity in flood time, is being continually washed and scoured away, and by the re-action of the sea during easterly gales, is driven back, and lodges the sand on the opposite flats on the Berwick side, (which is covered at high water,) and which has accumulated to a great extent; so much so, that, according to the evidence of some of the oldest pilots, the river's course has changed within the last twenty years more than 100 yards towards the village of Spittal, which now forms a very sudden bend greatly retarding the current, and presenting a bad channel for vessels entering the harbour. I am therefore decidedly of opinion, that unless steps be speedily taken to protect the south bank near the village of Spittal, and divert the channel into its old or natural course, a new channel will be formed by the water breaking through the narrow neck of the sandbank at Spittal Point, and still make further encroachments to the south, to the great injury of property.

To prevent this, and improve the river course and entrance to the harbour, two methods offer themselves.

1. I propose lining or facing the south bank slopes with rubble stone paved and set in a regular and even manner, according to the red curved line showed on the drawing No. 1. The slope to form an angle of 5 horizontal in 1 perpendicular, as represented on drawing No. 2. This stone work to be commenced with at the bridge, and continued downwards to near Spittal Point. The top part of the slope above high water mark to be continued horizontally 30 feet in breadth for the fishermen to draw their nets; at this breadth to have a parapet well of rubble masonry 4 feet high and 2 feet in thickness, built in a line, as marked on the plan No. 1. The space within this wall which is covered every tide, to be reclaimed by being filled with the ballast taken from the ships, &c., and also by the material required to be taken from the point on the opposite side, which can be easily excavated and conveyed in barges to the depth of low-water mark, and then deepened by a dredging machine.

By confining the river course within narrow bounds at this part, it would have the effect of scouring off the the point, and deepening the channel, besides reclaiming ground which would become valuable for building ships, timber-yards, &c. The plan is simple, and might be done at an easy expense.

APPENDIX C.

BERWICK.

No. 61.
Rhodes, on the Harbour of Berwick.

At the same time I find on inquiry that the fisheries being private property, and of such great value, that the stone pavement would be found objectionable, on account, as is supposed, of entangling their nets, and would therefore not be allowed. Under these circumstances, the second plan I have to propose appears unobjectionable, is equally effective for diverting the river course, and securing the channel, besides affording the means of shipping staiths, and other conveniencies, viz.:—

2. By constructing stone jetties or piers within the river, as represented on the drawing No. 1, and marked from No. 1 to No. 7, and also on the drawing marked No. 2.

The first of these jetties I propose constructing on a jutting rock or projection above the Tweedmouth batt, commencing by making a level bed for the first course at low-water spring tides, and projecting it as far into the river as may be found convenient, stepping up at every course to the apex of the rock. The breadth of the base is to be 22 feet, and at the top about 20 feet, the sides and end to batter three-quarters of an inch to the foot in height, to be carried up 4 feet above high-water ordinary spring tides; the walls to be 5 feet thick at the bottom, and 4 feet at the top. The whole to be built of Ashlar work, and to be composed of as large blocks as can be conveniently procured, finished at the top by a coping 3 feet 6 inches wide, and 1 foot 6 inches thick, and dowelled at the joints. A well for fixing a capstan or crane may be carried up from the surface of the rock, which will be found of great use. The jetties inside the walls to be filled with rubble stone or a concrete of lime and gravel, well mixed and thrown in, which will in a little time become consolidated and hard.

By extending this jetty on a level towards Mr. Robinson's foundry, it would be found of essential use in loading and unloading his material, as well as for other persons.

The second jetty I propose erecting on the Carr Rock,* a natural barrier and protection to the harbour, which, by time and the action of the water, has much worn away. A pier or jetty requires building upon this rock, in form as described on the drawing No. 2, elevated 4 feet above high water. To have a wall built for a crane or capstan, supplied with the necessary mooring rings for vessels, and a flight of steps on each side for the accommodation of boat passengers, &c. This jetty would be of great use for unloading ballast, which, together with a railway, waggons, and a crane for raising it out of the vessels, might be done at a cheap rate, besides filling up the waste ground.

The third jetty would require to be built about half way between the Carr Rock and the coal staith, similar to the first and second jetties, with this difference, that it would require sheet pile-driving all around the ends, and the two sides to low-water mark, secured by waling pieces and screw-bolts to prevent the current from undermining it.

The fourth jetty to be constructed *as an extension to the coal staith*, and to project 100 feet additional, to be built in form as represented on the plan and section. The foundation to be secured by sheeting piles of red pine or Dantzic timber, 10 feet long at the end of the pier, and diminishing inward to about 8 feet long. The piles to be 6 inches in thickness, shod and hooped with wrought iron; when driven the tops to be cut off level, and secured by a waling piece, 12 by 6, of Dantzic timber, and screw-bolts, 7-eighths square, bearing piles of larch 10 feet long and 8 inches in diameter, to be driven at the back of the wall, 4 feet apart, cut off level, and connected by a capping, or spring pieces epiked down to the top.

The walls to be of Ashlar work, similar to that before described, 5 feet 6 inches wide at the bottom, and 4 feet at the top, to batter 3-fourths of an inch to the foot in height, and to have coping similar to other jetties. The interior to be filled up with rubble or concrete, and the foundation stones to be large enough to reach from one row of piles to the other.

I should recommend the first, second, and fourth jetties to be built the first, before the winter floods set in, which will show the effect produced, the others may be built afterwards. I propose to build the parapet wall from the bridge downwards, as in the first plan, and pave the slope from the bridge to the first jetty, connecting the several fishing batts.

I trust I have explained everything necessary respecting the jetties, sufficiently to enable your foreman of the masons to understand and proceed with them. Particular care should be taken with the piling of the foundations, and securing them.

The general map, marked No. 1, has been enlarged from your old one, therefore I cannot rely upon its accuracy, but it is sufficient to explain my views for the improvement of the harbour. At the same time, it would appear desirable to have a correct survey made, so as to enable the Commissioners to see at any future period what alteration may take place in the harbour.

I am, &c.,
THOMAS RHODES.

No. 62.
Rhodes, on the state of the Works.

No. 62.

Second Report on the State of the Works, by THOMAS RHODES, Esq.

Febrary 25, 1836

SIR,

AGREEABLY to your instructions, I visited the harbour of Berwick-upon-Tweed in the month of November last. During my inspection I found one of the jetties or piers which I proposed on a former occasion to have been built on the Carr Rock, and which was in a forward state of completion. The masonry appears to have been well executed, and from its projection from the concave side of the river, promises to have the desired effect of altering the current, and scouring off a portion of the point or sandbank on the opposite side, particularly so when the required number are erected as marked on the plan.

No. 1 jetty, near Mr. Robinson's foundry, should be built the next; and as soon as it may be of the required height, the proposed retaining wall should be built nearly parallel with the river, as represented on the accompanying plan: to be carried up to the same level as the pier, and composed of dry rubble work, the materials to be as large as can be conveniently obtained, and which may be had close to the work from the rock or quay belonging to Mr. Dickson. The rubbish or baring from the surface of the rock will answer extremely well for backing the wall and filling up the waste space now covered at very high water. This part to be raised to the height of the wall, or 4 feet above ordinary spring

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* This jetty, and a wall from thence to Spittal of the same height, and a road inside 36 feet wide, have been erected and made; but all the other jetties and breakwater have not been deemed necessary, in consequence of the point of sand at the entrance of the river having regained its former height.

APPENDIX C.

BERWICK.

No. 62.
Rhodes, on the state of the Works.

tides, by which means it will reclaim a great extent of ground, and become valuable *for wharfs, staiths, and yards for ship building*, besides forming a good road from the bridge to the village of Spittal.

No. 3 jetty will form an addition at the coal staith, and will be a great improvement, enabling vessels to load and unload their cargoes with greater facility. This is the next to be constructed, and as it requires sheeting piles driving to secure and protect the foundations, it may be commenced with immediately, to be in readiness for the masons after the first and second are completed, the remainder to be built in succession.

On examining the encroachments made by the sea at Spittal Point, the beach of which is composed of sand and gravel, constantly moving and altering its position by heavy gales of wind, particularly those from the east and south-east by the action of the current of the river during floods, and the opposition and set of the tides at these times, rendering it exceedingly difficult, and attended with considerable risk and danger to navigate vessels in or out of the harbour,—what still adds to the danger and inconvenience is, the channel being so crooked, and often during these gales from the east and south-east, is greatly choked up by the sand and gravel, washed from along the south-east beach across the point into the channel, along the surface of the flats, and even carries it up as far as the ballast quay. During high water the harbour is very much exposed, and quite open to the in-run of the sea, which at times makes it unsafe for vessels to lie at their berths alongside the quay.

It is therefore quite evident that something is wanted to remedy the great evil complained of; and to render the harbour perfectly safe and tranquil, I propose running out a screen or breakwater,* (as shown by the accompanying plan and section,) in a north-east direction from Spittal Point, commencing in a line about the centre of the flank wall south of the flagstaff, in a direction about 500 feet westward of the light-house, along the pier, to the extent of from 800 to 1,000 feet length, more or less, according to the effect produced, and which will be best seen in the construction. I have no doubt but it will form a complete shelter or protection to the shipping inside the harbour. It will also be the means of improving the river course, as the current will have a greater effect in scouring out the sand, and keeping the channel open. The point or flat on the north side which is chiefly sand, may be reduced and deepened by dredging machinery, so as to give a greater space for ships in the harbour.

In the construction of the proposed breakwater timber framework planked outside, and the interior filled up with rubble masonry, would answer, and be less expensive than stone; still I would decidedly give the preference to stone, on account of its durability, and its being the cheapest in the end. For this purpose the accompanying plan and section shows the form which I consider the best for this situation. The curvilinear figure will break and resist the action of the sea better, and without disturbing the base or foundation, than a vertical one would do. I propose to secure the foundation with close sheeting piles 6 inches in thickness, fastened at the heads with waling pieces of the same dimensions in thickness, 14 inches broad, secured by screw-bolts. The piles to be caulked as far down as can be got, by which means it will keep the sand and gravel from washing out; the piles to be shod with iron, and driven down in the direction represented.

The face of the wall next the harbour to batter 4 inches to 1 foot perpendicular. This side will afford shelter for small craft, fishing-boats, &c.; and it is proposed to construct two flights of steps, forming an easy access to and from the pier. The top of the pier to be 10 feet wide, clear of the parapet wall paved; with the necessary mooring posts and rings, and two good capstans, for assisting vessels in and out of the harbour. The top of the pier to be surmounted by a parapet wall as a shelter, and to break the action of the sea. The whole of the pier to be built of good freestone, which can be obtained in the neighbourhood, to be in as large blocks as can be conveniently got, the beds and joints of the front Ashlar to be well worked, free from hollows and wanty places, and the face left rough. The backing to be squared and correspond with the front courses; the whole to be set in water cement, as will be more fully described in the specification and detailed drawings.

In the view I have taken for the protection of the harbour, I was glad to find (after making the survey, and submitting my opinion to your Commissioners, they allowed me a perusal of the late Mr. John Rennie's Report of the Harbour) that he appeared to coincide precisely with my opinion, and with what I have before stated. Speaking of the then projected works of the present pier, he says, "The sandstell will be shortened as well as the shifting sand to the eastward; but although by this means, the entrance for the vessels will be greatly improved, yet I fear a heavier swell will be thrown up the harbour, and render the berth of vessels lying at the quay, more uneasy and of course less safe than they now are. Should this prove to be the case in any considerable degree, a wooden pier or breakwater may be made from the Green Shore or point just before Spittal towards the north, having its head lying in such direction as to give a turn to the in-run of the sea at the entrance, and prevent it from rendering the berths of vessels at the quay unsafe: or perhaps a short jetty built from the rampart wall of the fortifications, to turn the face of the sea towards Tweedmouth, might answer the purpose, but I would greatly prefer the former. Powers should be obtained in the Act of Parliament, to enable the mayor and burgesses of Berwick to erect whichever shall be most eligible on trial after the North Pier is finished; but I have no doubt that from Spittal Point will, under all circumstances be preferred, if any is wanted at all."

	£.	*s.*	*d.*
In estimating the foregoing work, I calculated the pier, 800 feet long, equal to 12*l.* 10*s.* per lineal foot.	10,000	0	0
No. 7 jetties or piers at 400*l.* each	2,800	0	0
Retaining wall, and backing up from the bridge to Spittal Point	1,066	0	0
Capstans, mooring rings, buoys, &c., &c.	150	0	0
	£14,016	0	0

For the execution of these several works I should advise that they be let by contract,—the Ashlar work at per cubic foot, backing at per cubic yard, including quarrying the stone, leading, dressing, and building complete in the work; filling in at the back of the wall with quarry rubbish at per cubic yard; pile driving, including timber, at per cubic foot; iron work, in bolts, spikes, &c., at per cwt.

I am, &c.,

THOMAS RHODES.

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* Not built for the same reasons as in No. 2.

No. 63.

APPENDIX C.

BERWICK.

No. 63.
Cubitt, on the proposed Breakwater.

Report on the Harbour of Berwick-upon-Tweed, by W. CUBITT, Esq., F.R.S.

London, January 21, 1837.

GENTLEMEN,

ADVERTING to the correspondence between Mr. Pattison and myself, on the subject of my visit to Berwick to inspect the harbour, and with reference to the plans of Mr. Rhodes for securing its entrance, I have now the honour to report to you the result of my journey to that place, and my opinion of the particular plan proposed by Mr. Rhodes for the protection and improvement of that port.

The nature and extent of the imperfections of this harbour, and the disadvantages attending its entrance, in consequence of the unstable nature of the Spittal Point, are so clearly pointed out by Mr. Rhodes, as to leave but little to be said in addition thereto.

I arrived at Berwick on Monday, the 24th October, and on that and the two following days, made a careful examination of the harbour and its localities, accompanied by Mr. Thompson, the harbour master, to whom my acknowledgements are due for his attention to all my enquiries, and for the abundance of local information of various kinds relative to the subject, which he was so good as to afford me.

The harbour of Berwick is situated at the mouth of the Tweed, a large river, subject as most mountain streams are, to occasional heavy floods, and occasional short waters, at uncertain times; thus alternately producing contrary effects at its entrance, or discharge into the sea.

The mouth of the river is situated at the bottom of a bay open to the east, and the north side of the channel is defended by a very fine cut-stone pier, about 2,500 feet in length, with a light-house on its outer end.

On the south side of the entrance is Spittal Point, and in continuation of that a long low sandbank,* extending from the main land of the village of Spittal, almost to the pier, leaving a narrow shallow channel at low water, for the passage of the land waters; but over which bank of sand, the sea breaks and rolls freely into the harbour at high water, filling up the channels with sand, driving shingle up to the very quays of the town; and in storms or gales of wind from the south-east, causing much disturbance to vessels lying at the wharfs, which are at those times fully exposed to the heavy swell setting right over the sandbank between Spittal Point and the pier, into the harbour.

The shifting nature of the sandbank at the mouth of Berwick harbour is well described in Captain Johnson's Chart of the Harbour, and in his "Sailing Directions from Sunderland Point to Berwick," to which the chart is attached; and which together, contain apparently every information that could be wished with regard to this part of the coast for the use and guidance of the mariner.†

The great desideratum with regard to the improvements of this harbour is, to have such a plan as will do the greatest possible quantity of good to the harbour, with the least possible interference with the fisheries; and but for that consideration, there would be little difficulty in improving the harbour and its entrance, to a very considerable extent beyond what can be done whilst the present very crooked channel, and its circuitous shore lines, between the bridge and the pier-head, must y adhered to.

Mr. Rhodes has laid down a plan upon the best principles which, under all the circumstances, could probably be adopted, viz.:—

To secure the southern shore of the river, between the bridge and Spittal Point, by means of groynes, and dredging or digging off the opposite point on the Berwick side to some extent, in order to prevent the channel from further encroachment upon the village of Spittal, and to erect a cut-stone pier or breakwater on the sandbank from the Spittal Point, in a north-easterly direction for about 900 feet, in order to prevent the run of the sea over that bank into the harbour, and the constant shifting and shallowing of the channel; and also to ensure quiet lying for the vessels at the quays during the south-easterly gales; and a deeper and better channel and entrance to the harbour by diverting both the flood and ebb streams into a more definite channel and direction.

That beneficial effects would follow the carrying into effect Mr. Rhodes's plan, I have no doubt; but whilst admitting the principle upon which it is founded, and adhering to the plan itself very nearly, I differ with him as to the mode of constructing the breakwater. Instead of a cut-stone pier with a hollow curved face founded on the sand, and secured at foot with close sheet pilling and walings, I should recommend a simple breakwater of heavy rough rubble stone, carried out from the shore to its full height at once, as being a more simple, economical, and effectual means of producing the desired benefit; inasmuch as it is easier of accomplishment, can be carried on at all times of tide, and every yard in length producing its full effect as it is carried out.

The material for this work appears to exist in great abundance at Hudshead quarry, by the sea shore, about a mile and a quarter distant from the inner end of the proposed breakwater; and as a railway at present extends along a great portion of the distance, it is presumed that it would not be difficult to make arrangements by which that might become available to this work, which would probably lessen the outlay for preparatory measures; but even if a railway had to be laid anew for the whole distance, the work is of sufficient extent and importance to warrant such a measure.

The quantity of rough stone required for a breakwater of this kind, according to the section sent me by Mr. Blackadder, and on the red lines laid down on his plan, would be as follows, for every 100 feet; and supposing that 2*s*. per ton would, on a breakwater from 800 to 1,000 feet in length, include every expense of quarrying, carriage, and depositing, the quantities and cost would be as under:—

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* The works proposed became unnecessary by the sudden and unexpected rise of the point to its former height.

† For the copies of which book and chart, with a view to this inquiry, I am indebted to the present scientific and able Hydrographer to the Admiralty, who on this, as on every other occasion connected with the improvement of the ports, harbours, rivers, &c. on which I have had the pleasure and advantage of consulting him, is ready with every information that may be conducive to the proper understanding of the subject, and the advancement of the public service.

APPENDIX C.

BERWICK.

No. 63.
Cubitt, on the proposed Breakwater.

Hundred Feet.	Tons.	Per Ton.	Per Hundred Feet.			Total.		
			£.	*s.*	*d.*	£.	*s.*	*d.*
1st	320	At 2*s.*	32	0	0	32	0	0
2nd	700	At 2*s.*	70	0	0	102	0	0
3rd	1,210	At 2*s.*	121	0	0	223	0	0
4th	1,856	At 2*s.*	185	12	0	408	12	0
5th	2,421	At 2*s.*	242	2	0	650	14	0
6th	3,072	At 2*s.*	307	4	0	957	18	0
7th	4,050	At 2*s.*	405	0	0	1362	18	0
8th	4,866	At 2*s.*	486	12	0	1849	10	0
9th	5,456	At 2*s.*	545	12	0	2395	2	0
10th	6,405	At 2*s.*	640	10	0	3035	12	0
11th	7,782	At 2*s.*	778	4	0	3813	16	0
12th	10,100	At 2*s.*	1010	0	0	4823	16	0

To the above as the cost of the stone in place, must be added the first cost of preparing the railway, purchase of waggons, making piling engines and apparatus for driving the wooden jetty or frame to carry the railway upon, over the breakwater, all which I estimate might be done at a first cost of about 2,500*l.*, which outlay would be the same, whether the breakwater were to be 100 or 1,000 or more feet in length.

Then would come the expense of constructing the framing or piled jetty to carry the railway above the top of the breakwater, on which the loaded waggons would run and discharge the stones to the right or left to form the breakwater. The cost of this work, railway included, I estimate at the rate of 2*l.* per foot run for the first hundred feet; 2*l.* 2*s.* for the second hundred feet; and so on, advancing 2*s.* per foot every succeeding hundred feet, on account of the increasing length of the piles.

Next would follow the expense of the stone, deposited according to the foregoing table; and lastly, the regulating and facing up the slopes, inside and outside, after the sea has settled and knocked them about for a season or two; which I estimate at 2*s.* 6*d.* the square yard, to all which may be added in a work of this kind, subject to all the casualties of storms, &c., the large proportion of 20 per cent. for contingencies, taking all which into account, the following table will set forth the probable cost of any extent of breakwater from 1 to 1,200 feet.

Estimate.

Probable expense of railway waggons, piling, engines, and preparatory measures, £2,000.

Hundred Feet.	Railway Frame, &c.			Stone deposited.			Paving Slopes.			Contingencies.			Cost of each Hundred Feet.			Total Cost at the end of Each Hundred Feet.		
	£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*
1st	200	0	0	32	0	0	34	0	0	53	4	0	319	4	0	2,819	4	0
2nd	210	0	0	70	0	0	55	5	0	67	0	0	402	5	0	3,221	9	0
3rd	220	0	0	121	0	0	76	10	0	83	10	0	501	0	0	3,722	9	0
4th	230	0	0	185	12	0	97	15	0	102	13	0	616	0	0	4,338	9	0
5th	240	0	0	242	2	0	119	0	0	120	4	0	721	6	0	5,059	15	0
6th	250	0	0	307	4	0	140	5	0	139	9	0	836	18	0	5,896	13	0
7th	260	0	0	405	0	0	161	10	0	165	6	0	991	16	0	6,888	9	0
8th	270	0	0	486	12	0	182	10	0	187	17	0	1127	4	0	8,015	13	0
9th	280	0	0	545	12	0	204	0	0	205	18	0	1235	10	0	9,251	3	0
10th	290	0	0	640	10	0	225	5	0	231	3	0	1380	18	0	10,638	1	0
11th	300	0	0	778	4	0	246	10	0	264	19	0	1589	13	0	12,227	14	0
12th	310	0	0	1010	0	0	267	15	0	317	11	0	1905	6	0	14,133	0	0

I have been thus particular in order that the Commissioners may be able to see the probable cost of a breakwater of any determinate length; for instance, by looking at the tabulated estimate, it will be seen that the requisite preparations, a breakwater 200 feet in length would cost 3,221*l.*, and that one 500 feet long would be about 5,060*l.*; and one 800 feet long something more than 8,000*l.*, and so on to 1,200 feet; the total cost of which would probably be 14,133*l.*, to which would have to be added a contingency for the completion of a more exposed end.

The advantages of this mode of constructing a defence to the harbour are, that it does not require a superior class of workmen;—that it can be carried on to its full height at once, and during all times of tide;—that as the sea washes and settles the stones into the sand for a base, it is only to make good the settlement by adding fresh stones at the top until it becomes consolidated; and as it is difficult, if not impossible to say beforehand, what will be the precise effect of the sea on the foot of the breakwater, whether to take away from or to lay sand against it, that method is to be preferred which (as in this case) will render such casualties of less importance; for it is very probable, in my opinion, that some winds will remove the sand from the foot of the breakwater, and others lay it up again; consequently, a cut-stone pier, founded on sheet piling level with the sand, might be undermined and let down, from the sand being scoured away from its base, whereas the same circumstance would only render a rough rubble-stone breakwater more secure by merely settling it so much further into the sand, and rendering it still more secure against similar attacks of the sea.

Should there be any further information on this subject which it is in my power to furnish, or any explanation or particular point herein referred to, I shall be most happy to furnish either, on an intimation to that effect.

I have, &c.,
WILLIAM CUBITT.

No. 64.

No. 64. Rhodes's Third Report on the Harbour of Berwick.

Third Report on the Harbour of Berwick-upon-Tweed, by THOMAS RHODES, Esq.

Berwick, January 13, 1838.

GENTLEMEN,

SINCE my arrival here I have been favoured with your instructions, requesting my opinion relative to the best site and construction of a floating dock, for the accommodation of steamers and other vessels.

In compliance thereto I have turned my attention to this matter, and find that the site most likely for this purpose is on the Shad or low beach, washed up by the tide in front of the battery on the north side of the river, and which contains a space of about 60 acres in area, covered at spring tides.

I consider 40 acres of this space might be taken and appropriated for a floating dock,* made similar in form to what I have sketched out on the plan.

The dock to be capable of floating vessels drawing 14 feet water at neap tides; to have an entrance lock 180 feet long and 58 feet wide in the chamber, fitted up with two pairs of gates, with suitable machinery for working the same.

The dock to be enclosed with a quay wall of Ashlar masonry, puddled and made water-tight. A landing quay 80 feet wide, protected on the outside next the river with the rubble stone, sloped to an angle of 2 to 1, paid and laid evenly.

To make a correct estimate of the above, would be a work of considerable time and attention, but having considered the matter in a general way, and made the necessary calculations, I am enabled to give you my opinion, that such work as I have before stated could not be executed in a good and workmanlike manner for a less sum than 100,000*l.* to 120,000*l.* How far the Commissioners are enabled to lay out such a sum is not for me to say.

From the appearance of the present trade of the port, and the establishment of large steamers for trading along the coast, greater accommodation with depth of water is required to keep them always afloat, which can easily be obtained at a comparatively small expense.

To obtain this desirable object, I propose building a quay wall† of 400 feet in length, (which will afford berthage for three large steamers,) extending from the eastern termination of the new ballast quay down the river, as sketched on the plan.

To be built of Ashlar masonry, supported at the foundation with sheet and bearing piles driven sufficiently deep to support the superstructure.

The masonry to commence at or near low-water mark, and carried up to the level of the new ballast quay.

The triangular space from Coxon's Tower to the end of the quay wall, I propose filling up level with the top of the quay with ballast, protected on the eastern side by a rough rubble wall, formed of stones thrown in promiscuously, the outer face paved and formed to an angle of 2 to 1, and joined to the end of the Quay wall to protect it from the action of the sea, and prevent the gravel, &c. from being washed into the channel.

The entire channel from the harbour's mouth up as far as the bridge, I propose dredging‡ to the depth of 10 or 11 feet below low water of spring tides, and to near the front of the proposed quay wall, so that steamers, &c., can always lie afloat, take in, or deliver their cargoes.

If I am rightly informed, the channel or bed of the river is composed of gravel and sand to at least this depth, so that there will be no difficulty in the way of dredging, but on the contrary, it will be easily performed through the strata.

The material taken up by the dredging machine may be beneficially disposed of in backing the walls, and also in reclaiming the Shad on the north side, (and the waste spaces of ground on the south side of the river); in fact the whole of this space may be taken in, by extending rubble wall, as sketched on the plan, keeping it back from the channel of the river from 150 to 200 feet from the verge at low water, which distance, I apprehend, would be no way injurious to the fishing interest. Raising this space of ground by the accumulation of sand deposited in gales of wind; also ballast, and what is dredged up from the river, will form a good protection to the harbour, being quite sheltered, and it will be a means of directing the current into its proper channel, and keeping it clear and to the proper depth, so that vessels may enter and depart at an earlier state of the tide.

I have estimated these works as follows:—

	£.	s.	d.
Building the quay wall, 400 feet long,	5000	0	0
Dredging machinery, vessels, anchors, cables, &c.	2599	0	0
Six lighters,	900	0	0
	8499	0	0

Should the Commissioners approve of this plan, drawings and specifications will require to be made out for the construction of the wall, to be let by contract or otherwise; also for dredging machinery and barges.

The machinery will take from five to six months in being ready for operation.

The barges may be built here, and they will answer for conveying the rubble stone for building the protection walls.

Trusting the above may meet with your approbation,

I have, &c.,
THOMAS RHODES.

To the Harbour Commissioners, Berwick.

No. 65.

No. 65. Rhodes, on the Harbour and Works

Fourth Report by THOMAS RHODES, Esq., *on the Harbour and Works.*

Liverpool, September 14, 1838.

SIR,

ON my recent visit to Berwick on the 2nd instant, I beg to state in writing what I verbally explained to the Commissioners on the 4th instant.

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* Not built: too expensive for the trade and income of the port.

† Wooden jetties on piles, made in lieu of this quay.

‡ This has been done.

APPENDIX C.

BERWICK.

No. 65.
Rhodes, on the Harbour and Works

Having examined the dredging vessel and engine I found the vessel strong and well put together, as well as the engine and machinery, and when completed, I have no doubt of its doing the work of deepening the harbour efficiently.

The two lighters that I examined which were upon the stocks, and in progress of being built, (one similar to the model, and the other with a hopper,) for delivering the material and dropping it outside of the barbour; both of these are substantially built, and suitable for the intended purpose.

As it will frequently happen during easterly winds, &c., that the barges cannot be got out to sea, which would cause great detention, and throw the engine and men out of work, I would recommend the Commissioners to have all of them made with open holds, and close bottoms instead of hoppers.

Six of these lighters should be built with the least possibly delay :* in fact, to keep the engine properly at work, it would be better to build nine of them, which would be a saving of expense in getting the work out of hand, and they would be readily disposed of when the work is completed, (say in a year and a half,) at nearly the first cost.

In looking over the harbour for a site to deposit the material which it is intended to dredge from the bottom of the river channel, I find the most eligible spot on the south side of the river, and below the ballast quay, according to the line marked on the plan, and which I staked out previous to leaving Berwick. This space of ground, which is covered at high water, appears quite waste and useless, and by filling it up level with the Carr Rock jetty* (and the quays on the Berwick side), and extending up as far and in a line with the abutment of the south arch of the bridge, it will form a good road, wharfs for coal and fishing boats, besides making it useful for building ground and other purposes.

To keep the gravel, &c. from washing into the river, it will be necessary to build a retaining wall of Ashlar stone †, of the form and dimensions shown in the drawing, (appended to this Report,) the beds and joints to be well dressed and set in mortar; the face rusticated work, the back of the wall to be made up of a concrete of lime and gravel, 2 feet 6 inches thick, made in the proportion of six of gravel to one of lime.

As the foundations will vary in height according to the undulations of the ground, the building of the wall had better be let by the cube foot, or cube yard, measured in the work when completed.

At first I had some thoughts of building the face of the wall much more sloping, but upon consideration, the form which I would recommend will be found to answer better for vessels and boats lying alongside. (See sketch.)

The ground on the south side, as well as the piece below the ballast quay should be agreed for as soon as possible, in order to commence with filling in, and also with the building of the wall which may be done in lengths of about 100 yards at a time; the gravel, &c. should be levelled and made even as the wall is carried forward.

It might be as well to complete the south wall, and filling, in the first place, and afterwards build the rough wall, (according to the sketch which you have already in your possession,) and the filling on the Berwick side below the ballast quay.

During my stay at Berwick, Mr. C. Moor examined the plans and sections of the dredging required, and on mature consideration he has made out a tender, and sent it to me, for what he will do the several portions or divisions of the work, at per sum, or by the cube yard, measured from the section which is the most correct way for all parties, and I consider his tendered price of 7¼*d.* per cube yard as fair and reasonable. Providing the Commissioners agree to his proposal, you will please write to me as well as to Mr. Moor at York, so that he may prepare himself to commence operations immediately.

Previous to Mr. Moor commencing, it might be as well for you to draw up an agreement or contract deed, so as to bind him to the work, and for the satisfaction of the Commissioners.

A daily account of the dredging should be taken (by a confidential person on the part of the Commissioners) of the barges when loaded from the machine, specifying the tonnage, which can easily be reduced into cube yards by ascertaining the weight of a cube yard, which will be found to be from 29 cwts. to 30 cwts.

The first division of the dredging should be commenced with the first, and completed; then the second; and lastly the third.

The retaining wall should be commenced with building at the Carr Rock, completed and continued upwards to the bridge; and by filling and levelling the ground at the back part, it will become valuable property.

I am, &c.,
THOMAS RHODES.

P. S.—Mr. Moor might give you a tender for the retaining wall, if you think proper.

T. R.

No. 66.
Rhodes's Fifth Report on the the Works of the Harbour.

No. 66.

Fifth Report of THOMAS RHODES, Esq., *on the Works of the Harbour.*

SIR,

Liverpool, September 27, 1838.

ON my arrival here yesterday morning I found yours of the 19th instant, with the plan of the harbour of Berwick, and requesting my opinion on several points, which I beg to state as follows, viz.:—

1. As to the dredging, I would strongly recommend to the Commissioners that the river course should be deepened along the first, and part of the second divisions, or down in a line opposite the Carr Rock to 10 feet deep from low water mark, and 300 feet wide, which will afford a sufficient depth and ample space for steamers and sailing vessels to lie afloat at all times.

When this part is completed, containing about say 150,000 cube yards, the Commissioners will then be able to judge how much further it will be necessary to proceed.

2. I should also recommend you having the work done by contract, and I have no doubt Mr. Moor would do it at the same rate of expence, 7¼*d.* per cube yard, for either 6 or 10 feet in depth. This

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* Done. † Intended.

No. 66.
Rhodes's Fifth Report on the Works of the Harbour.

price at which he has offered is much cheaper than you can do it by day-work, which should always be avoided if possible.

The quantity of material taken out of the channel can easily be ascertained from the section, or at the place where it is deposited, when once the ground is determined upon, staked out, and a section of the same taken, forming a check on each other, besides taking the tonnage of the lighters.

3. The ground you have marked out in red pencil on the map on the Berwick side is barely sufficient to contain the material, measuring 462 yards long, 171 yards broad, and say 1½ yards average depth to quay level is = 118,503 cube yards; you ought, therefore, to extend and purchase the part next the river, as I have marked out by the dotted red ink line.

4. As regards the breakwater, all that is necessary at present is to throw in rough rubble stones promiscuously, in the line or boundary marked next the sea; and after the stone has got settled to pave the face in a regular manner to about an angle of 45 degrees.

As I have not got a copy of the plan and section, might it not be better to get the plans, &c. from Mr. Brickwood for a few days, and trace this part off the same.

The rubble stone may easily be obtained from the Carr Rock quarry, in as large blocks as can be got, which will answer the purpose very well.

5. I cannot help thinking that the Commissioners should endeavour to purchase the ground on the Tweedmouth side of the river, provided it can be obtained at a reasonable rate, (as well as that on the Berwick side) My reason for proposing to build an Ashlar wall on this side of the river was, that it would be a great accommodation for boats lying alongside. At the same time, a rubble stone wall, paved on the outside, as proposed for the breakwater on the opposite side, would answer for keeping up the material (dredged from the channel of the river) equally well, and might be executed at a much less price.

6. As soon as the dredging-machine is ready and the ground purchased, you will please let Mr. Moor know, so that he may be preparing to commence operations.

Probably Mr. Moor might be induced to superintend the work for you at a salary, and set the work to the men by contract. But taking everything into consideration, I think the first plan would be the best; that is, let Mr. Moor do the work and furnish everything at 7¼*d.* to the cube yard, so as to devote the whole of his time and energies to this particular work.

You might let him have the breakwater by contract also at per cube yard, to supply the stone and workmanship, or as the Commissioners may think proper.

I am, &c.,
THOMAS RHODES.

No. 67.

No. 67.
Case and Opinion as to Liabilities of Commissioners to lay their Accounts before the Town Council.

Case and Opinion as to Liability of Commissioners to lay their Accounts before the Town Council, and the Power of the latter to enforce a more full Statement of Income and Expenditure.

Case.

A QUESTION has arisen respecting the sufficiency of the Statement of the Accounts of the Berwick Harbour Commissioners, rendered by them to the council of the borough of Berwick-upon-Tweed, in pursuance of the section of the Berwick Harbour Act, 48th George III. (page 43 in the copy accompanying this.)

Prior to the passing of that Act, the harbour was entirely under the management of the corporation of the mayor, bailiffs, and burgesses of the borough of Berwick-upon-Tweed, who levied to their own use (or let to farmers) the dues then payable on goods, and on the shipping using the port, (from many of which those belonging to freemen were then wholly exempt,) and they expended such portion of them as they thought fit on the repairs and improvements of the harbour, but they gave no account of the remainder to any one. The items of revenue and expenditure on this account, were, like others regularly examined by a committee, included in the treasurer's accounts of the corporate receipt and expenditure, and laid before the guild or corporate meeting. This was a general meeting of all the freemen of the borough, at which every one had an equal vote and voice.

The present Act was procured upon their petition and solicitation, which may account for the clause in question being inserted.

A statement of their accounts has from the beginning, yearly been rendered to the corporation. The form of it has scarcely varied.

These statements of accounts have at no time been satisfactory to the corporation; but in consequence of the adverse state of feeling which at and for long after the time of the passing of the Act prevailed in the corporation on the subject of it, (owing to its depriving them of the revenue from this source, and subjecting the freemen to the same payments as others,) the more enlightened members of the corporation, desirous to shew their confidence in the Commissioners, generally stifled all attempts at investigation and inquiry.

5 & 6 Will. IV., cap. 76.

Since the passing of the Corporation Act, the Commissioners have continued as formerly, to render their accounts to the council, substituting the quarterly meeting in August, for the head guild next after Midsummer. This, it is presumed, they are correct in doing, inasmuch as although there be now no head guild, or adjournment of one, nor any bailiffs, yet by the 6th section of the Corporation Act, "the mayor, aldermen, and burgesses of every borough, shall be capable in law to do and suffer all acts which they and their successors respectively might and could do and suffer by any name or title in the corporation;" and the head guild, at which it is ordered that the accounts be presented, may be held to be merely directory. It is, however, thought necessary to call the attention to this point, as it is understood that the Commissioners somewhat rely upon the words of direction being now inapplicable to the corporation, as now constituted.

The following is a copy of the account rendered to the last quarterly meeting, on the 6th August last:—

"A Statement of the Accounts of the Commissioners acting under an Act of Parliament of the 48th Geo. III., intituled 'An act for rebuilding the Pier and for improving the Harbour of Berwick-upon-Tweed,' from 12th July, 1843, to 12th July, 1844."

APPENDIX C.

BERWICK.

No. 67.
Case and Opinion as to Liabilities of Commissioners to lay their Accounts before the Town Council.

Dr. *The Commissioners.*	£.	s.	d.	*Contra.*	£.	s.	d. *Cr.*
To Shore dues, inwards . .	1,011	14	7¾	By Balance due Commissioners last year	12,417	7	4¾
To Shore dues, outwards .	1,038	6	0¼	By paid interest . . .	549	18	0
To Tonnage duty . .	665	14	4¼	By salaries, rents, attorney, and clerks' bills, &c. . .	441	8	4
To Harbour duty . .	115	6	8	By materials and repairs .	49	11	10
To Ballast, inwards . .	104	10	5	By pier quay, light-house, &c. .	970	9	11½
To Ballast, outwards . .	19	19	8				
To Crane dues . . .	5	16	5				
To Bank interest . .	6	8	8				
To Balance due, Commissioners	11,460	18	7				
	£14428	15	6¼		£14,428	15	6¼

THOMAS THOMPSON, *Collector and Treasurer.*

The council considering this as an insufficient and unsatisfactory statement, and a mere evasive compliance with the Act, they resolved to call for a more detailed and particular account. Therefore the town clerk on their behalf wrote to the collector as follows :—

August 10, 1844.

"I have laid before the council your Statement of the Accounts of the Harbour Commissioners, from the 12th day of July, 1843, to the 12th day of July, 1844, and I am commanded by the council to require that you render to me, for their use, a more detailed and particular account of the receipts and expenditure of the Commissioners for that period.

"The next meeting of the council is fixed for Tuesday, the 3rd of September next, before which time I shall expect the favour of some communication from you.

T. GILCHRIST, *Town Clerk.*

In reply to this he received the following answer from their clerk :—

August 22, 1844.

"At a meeting of the Berwick Harbour Commissioners held this day, I was directed to acknowledge the receipt of your letter of the 10th instant, to Mr. Thompson, their collector and treasurer, wherein you intimate that you had laid his Statement of the Commissioners' Accounts, from the 12th July, 1843, to the 12th July, 1844, before the council, and that you were commanded by them to require him to render a more detailed and particular account. The Commissioners direct me to express their surprise that the council should have made such a demand, particularly as the statement rendered is in form precisely the same as that annually delivered for the last thirty-six years, and unobjected to. They further direct me to intimate, that they are advised by counsel that the statement rendered by Mr. Thompson is a sufficient compliance with the requisition of the Harbour Act.

CLEM. PATTISON.

In consequence of this reply, the council have resolved now to bring the point to settlement, feeling convinced of the utter insufficiency of the accounts rendered.

Your opinion is therefore requested,—

1. Are the Harbour Commissioners still bound to render a statement of their accounts to the council of the borough, notwithstanding the change of its constitution by the Corporation Act?

2. Is the Statement of Accounts rendered by the Harbour Commissioners a sufficient compliance with the requirement of the Act of Parliament?

3. In what way ought the council to proceed to enforce a more full and satisfactory statement? Must they particularise the points, in which it is deficient, and demand information upon them? or what is the proper course for them to pursue, and what are the remedies at law or in equity which they must resort to to enforce compliance?

4. Have the council by the Act any powers of auditing the accounts of the Commissioners? and to what extent do their powers go in enquiring into and allowing or disallowing any accounts?

Be pleased to advise the council generally on the points above submitted to you.

Opinion.

1. I think the Harbour Commissioners are still bound to render a statement of their accounts to the new corporation, notwithstanding the change in its constitution; it still remains, in law, the same body, and in my opinion the council are entitled to have the statement of the accounts made to them. The particular meeting at which the statement is directed to be made would, I think, be held to be directory.

2. I am inclined to think that the statement of the accounts as made within would be deemed to be sufficient. It is quite true that it really amounts to very little: but as I think, the corporation have no power of auditing the accounts or curtailing the expenditure. and that the only end to be attained is the giving some publicity to the proceedings of the Commissioners. I think a jury would probably find (in the absence of suspicion of improper conduct on the part of the Commissioners, which is not suggested) that the statement was sufficient. By the section in page 27, the rate and duties are to be paid to the Commissioners; and by that in page 30 and 31, the application of them is directed, and the entire control seems to me to be given to the Commissioners; and I do not find any section giving any superintending authority to the corporation. The section in page 43 directs the statements of the accounts to be annually produced, but the only matter enacted is as to the production; and I do not think the section gives to the corporation any power whatever in respect to the allowance or disallowance of the time as to the item on the debit side. I do not see what further information could be given, except a statement of all the payments, when and by whom made, &c., was to be given; and I do not think the words, "statements of the accounts" require such particularity. Indeed, I think the particularity which a jury would require would, in a great measure, depend upon the circumstances under which the indictment was preferred. If there was any reason for suspecting misappropriation, a jury would probably require strictness and particularity; but if nothing of the kind was suggested, they would, I think, be satisfied with greater generality. On the credit side the item of 441*l.* 8*s.* 4*d.* ought, perhaps, to be divided, and as the &c. includes any other items, it would certainly be insufficient, but considering that the term is the same which has been so long used without objection, my impression

APPENDIX C.

BERWICK.

No. 67.
Case and Opinion as to Liabilities of Commissioners to lay their Accounts before the Town Council.

is that a jury would deem it sufficient; and upon a question, which I consider would be one for a jury, it is impossible to give anything like a positive or satisfactory opinion.

3. The first step to be done is certainly to point out in what respect the account is deemed to be unsatisfactory, and to require further information, and in the event of legal proceedings being taken, the form would be an indictment. If no statements at all were made, I think the Court of Queen's Bench would probably interfere by mandamus, but I think they would not upon a proceeding of that kind try whether or not the account rendered was sufficiently precise and particular. Any proceeding in equity would be at the suit of the Attorney-General acting for the public.

4. I think the corporation have no power to disallow any of the items. The commissioners seem to me to be independent of the corporation, and that if they make a sufficiently precise and particular statement to satisfy a jury they will have complied with the Statute.

It is quite true that the account rendered is really no check, and of little use: but I think it very likely that the intention was that the Commissioners should have absolute control, and that the section in page 43 was inserted merely for the purpose of throwing dust in the eyes of some parties who were anxious to support the right of the corporation. In the event of any improper conduct on the part of the Commissioners, the most effective remedy would be an information at the suit of the Attorney-General; but unless there are good grounds for suspecting something to be wrong, no step of this kind ought to be taken. I cannot advise the corporation to incur any expense, or take any legal proceedings against the Commissioners in respect of the insufficiency of the account. I think the sufficiency or non-sufficiency would be a question of fact for a jury; and considering that the form is the same which has been used for so long a time, I greatly doubt whether it would be practicable to obtain a conviction. If the question were entirely new, I think the statement required ought to afford the means of testing its accuracy by reference to persons and dates, but after a submission for 36 years to the present form of statement, the question becomes a very different one. The application for further information may properly be made; but as at present advised, I cannot recommend legal proceedings, in the event of refusal to afford it.

Culmer, September 25, 1844. S. MARTIN.

No. 68.

Memorial of Shipowners, &c., to the Commissioners of Berwick Harbour, on the want of a Break water, and proceedings thereupon.

No. 68.
Shipowners' Memorial on the want of a Breakwater, &c.

The Memorial of the undersigned Shipowners and Masters of Vessels trading out of this Port—

SHEWETH,

THAT, in consequence of the lowness of Spittal Point, this harbour is at present very much exposed to the sea during easterly gales, which causes such a swell in the river, that the shipping to the quay can scarcely be held to their moorings, and in some instances, lately, have sustained considerable damage.

That, from the same cause, there is no part within the harbour where vessels can be placed in safety for the purpose of being repaired, which is a serious disadvantage to the shipping interest of the port, and may be attended with much loss.

That a breakwater, reaching from the Tower to a certain distance in the river, would be an effectual remedy against the evils complained of, which your memorialists are informed could be erected at a comparatively small expense; and also that a plan and report, with the view of such an erection being made, were drawn out some years ago by Mr. Rhodes, under the direction of the Commissioners, to which your memorialists would beg leave to refer.

Your memorialists would therefore beg leave respectfully to call your attention to the facts here stated, and hope that you will be pleased to cause a breakwater to be erected, or that you will take such other steps for improving the state of the harbour, as under the circumstances, you may consider best.

For the Berwick Shipping Company,
WILLIAM PAULIN, and 31 others.

Berwick, February 22, 1845.

Extracts from Minutes of Proceedings of the Harbour Board, at their Meeting on the 27th February, 1845.

AT a meeting of the said Commissioners, held the 27th day of February, 1845; present:—John M. Dickson, Esq.; Geo. Gilchrist, Esq.; Mr. James Marshall; Mr. John Wilson; Mr. James; Mr. Henderson; George K. Nicholson, Esq.; Mr. Robert Crossman; Mr. Cunningham; Mr. Dewer; Mr. Dunlop; Mr. J. Clay:—

A memorial from the shipowners and others was this day presented to the Commissioners requesting that they would be pleased to erect a breakwater on the shore, as recommended by Mr. Rhodes. The same was referred to Mr. Moor for his report thereon, and as to the probable expense thereof.

Memorial answered the 27th March, 1845, as follows:—

SIR,

THE Commissioners this day took into consideration Mr. Moor's report upon your memorial, and they have instructed me to say that they are advised that the breakwater suggested by you would not have any beneficial effect. They will, however, bear your application in mind, and endeavour to remedy the evil you complain of.

I am, &c.,
CLEM. PATTISON, *Clerk*.

To Mr. Wm. Paulin.

APPENDIX C.

BERWICK.

No. 69.
Moor, on the inefficiency of proposed Breakwater.

No. 69.

Mr. C. Moor on the inefficiency of the Breakwater prayed for in Shipowners' 'Memorial of the the 22nd February, 1845.

GENTLEMEN, *March* 13, 1845.

IN accordance with your instructions, I have carefully considered the memorial addressed to you, and signed by a large number of shipowners and masters of vessels trading out of this port, shewing—

1st. That, in consequence of the lowness of Spittal Point, the harbour is at present very much exposed to the sea during easterly gales, causing a heavy swell in the river, and that during these gales the shipping can scarcely be held at their moorings, and that in some instances lately considerable damage has been sustained.

2nd. That, from the same cause there is no part within the harbour where vessels can be placed in safety for the purpose of being repaired.

To remedy the above evils your memorialists proposed the erection of a breakwater from Coxon's Tower, in the position shown on the plan, to a certain distance into the river.

I have also (through the assistance of Mr. Pattison) examined plans and reports relating to the improvement of the harbour, from 1806 to the present time, from which, together with my own opinion, the following report is drawn up and submitted to your consideration.

In the first place, I quite agree with your memorialists, that at present there is a considerable range in the harbour, more particularly at the low ballast quays, owing entirely to the lowness of Spittal Point.

But that a breakwater, as proposed, would remedy the evil I would very much question, for this reason, that the swell which comes to the ballast quay does not come in that direction.

The swell that rolls over the Shad comes from the sea to the N.E. of Shoreside Batt, and strikes the walls at an angle of about 60 degrees where the swell breaks.

To the S.W. of Shoreside Batt the swell runs in the direction of the Carr Rock, or betwixt that and the Foundry, when a reaction takes place by coming in contact with the Carr Rock, the Black Rock, and the batts on the south side of the river, where it receives a fresh impetus, and rolls up the Shad to the ballast quays; betwixt the swell from this point, and that N.E. of the Tower is all broken water, whence the natural sand ridge is formed.

In referring to the reports I have had the opportunity of seeing, relating to the harbour by the most eminent engineers, I find nothing to make me alter my opinion, viz., that a breakwater, as proposed by your memorialists, will not have the desired effect.

Mr. Rennie appears to have been apprehensive of Spittal Point being shortened or lowered by the building of the present pier, and thereby increasing the inlet of the sea to the danger and damage of the shipping at the quay, when he says, "Should this be the case to any considerable extent, a wooden jetty or breakwater may be run out from the green sward in a northerly direction, or perhaps a breakwater run out from Coxon's Tower to turn the sea towards Tweedmouth, might answer the same purpose, but I would greatly prefer the former."

Mr. Rhodes, in noticing the breakwater, appears to be committing to writing what he had previously stated verbally. He says, "As regards the breakwater, all that is necessary to do at present is, to put down rough stones, and after they have got settled, to pave the face next the sea in a sloping direction, but does not say for what purpose the breakwater is intended."

My opinion is, that a breakwater, as proposed, would not have the slightest effect, good or bad, as respects the harbour, until it reaches a certain point over the ridge. That point is about 150 yards from the Tower, in a direction a little east of the Carr Rock, after which continue it, say 53 or 100 yards further, and the effect would be, that the first quarter ebb, (which alone is injurious to Spittal Point,) instead of passing over the Shad, as at present, would be directed with greater violence into the bight below Spittal, and, consequently a larger body of the flood waters would pass over the point and tend to run it away, and in the same ratio the north point would gather.

Instead of the breakwater as proposed, I would propose the continuation of the ballast quay to the extent of 280 feet, which would answer all the purpose that could possibly be expected from the breakwater.

By adopting this plan, three ships' berths would be obtained, or berths for two large steamers; and by building it on sheet and bearing piles, it may be deepened in front by the dredging machine, and close to the piles, by a spoon dredge fixed on one of the lighters to the depth of the bed of the river, viz., 7 feet at low water, the strata being favourable for this operation.

These would be the most suitable berths for large ships, such as are in the harbour at present, or for timber ships, or any vessels with bulky cargoes, on account of the quay room it would afford.

By adopting this plan, the steamer jetties may be removed, and the front of the ballast quay cleared away, and the whole range of quay made available for ships to load and discharge at, as there would then be no accumulation of sand or gravel.

It may be said that there will be still no part within the harbour where vessels can be laid on shore in safety for the purpose of repairing. In answer to which I would say that a more desirable place could not be wished for than Tweedmouth shore, where the ground is level and clean, and plenty of moorings. The only disadvantage is the distance from the ship yard.

To return to Spittal Point:—I have no doubt in my own mind but the point will soon be up again, and the harbour tranquil; but a little dredged off the opposite side of the river, commencing at the Hope and working upwards, would greatly assist nature in the operation by diverting the ebb tide to the north, and easing the current over the point.

The north point above the Hope is fast approaching the river channel, and will in time get so far as to cause the freshes to cut through the point instead of over the end as at present, when it will be more difficult and expensive to get up.

I would therefore recommend the north point to be kept back by dredging to a distance, say to what it was dredged a few years ago. By doing so, it causes the ebb tide to act on the low end of the Spittal Point, and turn it to the south, giving more room to vessels clearing Crabbwater Rocks, as well as facilitating the rising of the point, the natural breakwater.

I would recommend forthwith a few weeks' dredging at this place before the throng of the fishing sets in.

APPENDIX C.

BERWICK.

No. 69.
Moor, on the inefficiency of proposed Breakwater.

The following is an estimate of the cost of the breakwater, the stone proposed to be got out of that part of the Tweedmouth quarry lately in the occupation of Mr. William Brown. The length, as on the plan, viz., 200 yards —

	£	*s.*	*d.*
To Reding quarrying, and leading stones 2,100 tons . . .	472	10	0
To weighing and packing stones, and incidental expenses . .	105	0	0
Total	£577	10	0

Estimated cost of 280 feet of quay, as proposed, including piling, stone work, iron work, fenders, &c., and complete filling up behind not included	£1,495	0	0

I am, &c.,
CHRISTOPHER MOOR.

To the Harbour Commissioners, Berwick.

No. 70.
On the Want of Landing-places on the South side of the Tweed.

No. 70.

Memorial from Merchants, Manufacturers, &c., and Correspondence on the necessity of further Accommodation for the Landing and Shipping of Goods, on the South Side of the Tweed.

THE undersigned merchants, manufacturers, and others who are extensively engaged in the commerce and trade of the port of Berwick, and whose business and interests are seriously impeded and injuriously affected by the want of proper facilities and accommodation for landing and shipping goods on the south side of the river Tweed within the said port, beg respectfully to request that you will provide such wharfs or landing-places as they may deem to be justly due to, and imperatively called for by, the traffic which exists on the south or Tweedmouth side of the said port, and which contributes very largely to your revenue. Dated this 27th day of February, 1846.

J. and A. ROBERTSON & Co., and 37 others.

To the Commissioners of the Port of Berwick.

SIR, *Tweedmouth, March* 4, 1846.

THE enclosed Petition from persons connected with the trade of the port, and whose business requires the proper means for shipping and landing goods on the south or Tweedmouth side of the river, has been intrusted to me for transmission, through you, to the Harbour Commissioners; and I have, on the part of the Subscribers, respectfully to solicit the early attention of the Commissioners to the subject.

I am, &c.,
ALEX. ROBERTSON.

Thomas Thompson, Esq., Harbour-Master.

Extracts from Minutes of Proceedings of the Harbour Board at their Meeting on the 2nd April, 1846.

Extract from Minute Book.

At a meeting of the said Commissioners, held the 2nd day of April, 1846; Present:—John M. Dickson, Esq.; P. Clay, Esq.; Mr. Dunlop; Mr. Marshall; John Clay, Esq; Mr. Dewar; Colonel Hogarth; Mr. Cockburn; Mr. Cunningham;—

A memorial from the merchants, manufacturers, and others, engaged in the trade of this port, requesting the Commissioners to provide wharfs or landing on the south side of the river, was this day laid before the meeting; and it was resolved that the following answer be forwarded to Alexander Robertson, Esq.:—

SIR,

I AM directed by the Berwick Harbour Commissioners to inform you that the memorial which you forwarded to them on the 4th ultimo, relative to wharfs or landing-places on the south side of the river, was this day laid before their meeting; and I was instructed to intimate that, owing to the Commissioners having no surplus funds at their disposal, they deem it inexpedient to increase their present debt by making any additional erections on the south side of the river until it is ascertained what effect the present railways may have on the revenues of the port. The Commissioners will, however, keep the memorial in view, and when their funds will admit of it, they will again take the same into consideration, having every wish to afford accommodation to the merchants and others connected with that side of the river.

I am, &c.,
CLEM. PATTISON, *Clerk.*

SIR, *Tweedmouth, April* 9, 1846.

ON my return from London last night, I received your letter of the 2nd, from which I find that the Harbour Commissioners decline affording proper accommodation to the trade of this side of the river.

No. 70.
On the want of landing places on south side of the Tweed.

In order that I may place the matter fairly before the subscribers to the memorial, which I presented on this subject, I have to beg from the Commissioners the following information :—

The amount of the existing debt referred to by you.

The totals of income and expenditure, respectively, during the last ten years, stated annually.

The estimated cost of erecting a landing-place for Tweedmouth.

The cost incurred in making the roadway and walls for Spittal.

The amount for one year, up to the 31st ult., of harbour dues received from the parties subscribing the memorial.

The total amount of shore dues received during the same period.

I may just state here, that the indisposition evinced to do justice to the trade of Tweedmouth must of necessity drive many of the memorialists to effect arrangements with the railway companies for the transport of articles, which would more naturally be conveyed by sea if an accommodating spirit were acted upon by the authorities of the harbour.

I am, &c.,
ALEX. ROBERTSON.

Clem. Pattison, Esq.,
Clerk to the Commissioners.

Extracts from Minutes of Proceedings of the Harbour Board at their Meeting on the 23rd April, 1846.

AT a special meeting of the said Commissioners, called by the Chairman pursuant to the Act, held the 23rd April, 1846; Present:—John M. Dickson, Esq.; Mr. Marshall; Mr. James; Mr. Cockburn; Mr. P. Clay; Mr. Dewar; Mr. Dunlop; Mr. Henderson; Mr. Cunningham; George Gilchrist, Esq.; George K. Nicholson, Esq.;—

Mr. Pattison laid before the meeting a letter he had received from Alexander Robertson, Esq., Tweedmouth; and he was directed to forward the following answer to Mr. Robertson :—

SIR,

I LAID your letter of the 9th instant before the Harbour Commissioners at their meeting to day, and I was instructed to refer you to their Annual Statement delivered to the town council pursuant to the Harbour Act, and to their letter to you of the 2nd instant.

I am, &c.,
CLEM. PATTISON, *Clerk.*

SIR, *Tweedmouth, April* 24, 1846.

I AM this morning in receipt of your letter of yesterday's date. The Harbour Commissioners, you tell me, refer me to their annual statement, delivered to the Town Council. This is really a sorry jest, for if the concentrated wisdom of the Town Council could not extract any information from the annual statement, it cannot be expected that my individual ignorance could glean even an approximation to any useful fact.

As the Harbour Commissioners do not seem inclined to promote the trade of the port, even within the limits of their strict duty, they must not be surprised if many of the memorialists, in self-defence, make arrangements for their goods being land-borne. It will be necessary to make this correspondence public, for the information of the memorialists and others.

I am, &c.,
ALEX. ROBERTSON.

C. Pattison, Esq.,
Clerk to the Commissioners.

No. 71.
Guthrie, on the Proceedings of the Harbour Board.

No. 71.

Letter from ROBERT GUTHRIE, Esq., *to the Tidal Harbour Commissioners, on the Proceedings of the Harbour Board.*

SIR, *Helen Iron Works, Berwick-upon-Tweed, November* 28, 1846.

IN obedience to the request contained in your letter, which I received on the 16th instant, that I should furnish the Commissioners of Tidal Harbours with any information respecting the port of Berwick, I have now the honour of transmitting some accounts for their inspection, which I trust may prove useful in furthering the objects to which their attention has been directed. The meeting which one of your Commissioners, Captain Washington, held here some time ago, not having been previously announced, either from accident, inadvertence or design, by the parties connected with this port, I was not made acquainted with it until near its close, and was, in consequence, unprepared to make any statement, or offer any suggestions on the subject; which I the more regretted from having for some years taken an active part in endeavouring to obtain a reform in our Harbour Act, the evil effects of which most of our traders and manufacturers, as well as myself, have long experienced. The information which Captain Washington obtained at that meeting must of course have convinced him of the necessity of a total revision of that Act; but as it appeared to me, from reading a report of it in the public prints, that that information was incomplete, and many cases of importance entirely overlooked, I shall endeavour to furnish you with a more detailed view of the case, even at the risk of a repetition of some facts which you already know.

The harbour, tonnage, and shore dues of Berwick, previous to 1808 were the property of the corporation of the town. They were then irregularly collected, sometimes being farmed out, and sometimes received by the officers of the borough. Their schedule was imperfect, and confined to a few articles; a distinction being made in favour of the burgesses of the town, lesser dues being charged upon their merchandize than upon goods the property of non-freemen. Some years previous to 1808, the pier built in the reign of Queen Elizabeth was found so insecure and worthless, that a new one became necessary. Either from the want of sufficient funds to build a new one, or from an apprehension that the revenues of the harbour would be unproductive, from intrigue, or from some other cause of no importance now, the corporation gave up all claim or right to the exaction of shore or harbour dues of any kind, to eighteen Commissioners, who prepared and carried the present bill through Parliament in that year. Under the provisions of their Bill the present pier was built, a new schedule of dues levied, and the Commissioners invested with extraordinary powers; the most surprising, and perhaps the most obnoxious, being that of nominating their successors, or filling up any vacancies that might occur from resignation or death. It conferred upon them the power of licensing pilots, of purchasing lands for the improvement of the harbour, of erecting quays, harbours, wharfs, &c.; and in fact they became, and are now, the conservators of the Tweed. The only reservation which the corporation obtained, in thus giving up their ancient right to the collection of the harbour revenues was, that the new Commissioners should produce to them annually a statement of their accounts; and how faithfully, and perhaps ingenuously, this solitary memento of "the powers that were" has been fulfilled, the sequel will shew.

The Bill was passed. The Commissioners, not invested with "brief authority," but authority for life, hastened to perform their new duties. Rennie, the celebrated engineer, furnished a plan for the pier; a railway was made to a neighbouring quarry, and with this exception, manual labour did the rest; for, after years of toil, and disdaining, or perhaps being ignorant of the use of any machinery or invention by which the works might be facilitated, and the cost lessened, the pier was completed; not, however, in all its integrity. Engineers are, or ought to be, very clever people; and as the one in question had for years devoted all his talents and time in the construction of harbours, breakwaters, docks, and piers, and in every one successfully, it might have been confidently supposed that his plan for the improvement of the entrance of our harbour would have been a most judicious one. The Commissioners were, however, of a contrary opinion. Rennie's plan was to form the pier in a straight line, so as effectually to protect the river from the surge of the sea, and for other equally cogent reasons, which his long experience in such matters had taught him; but our self-appointed Commissioners thought otherwise. The plan was altered; a bend or elbow made in the structure,—decidedly departing from Rennie's intentions and advice; and though mariners, pilots, and people well acquainted in nautical architecture, agree to a man in declaring that the pier is rendered almost useless in consequence, still, were we in possession of the reasons of our "conservators," I have no doubt that all who look upon the irregularity of the proceeding, and the crooked nature of the structure, would be perfectly satisfied and convinced of the wisdom of our Commissioners.

I point out the circumstances without the most distant intention to bring the conduct of the Commissioners into ridicule; and I most earnestly entreat of your Honourable Board to refrain, if possible, from doing so. My object is to shew, in the present instance, how desirable it would have been for this port, had a Bill, such as you have prepared, been in force and acted upon then. I am perfectly persuaded, that under proper management the cost and construction of our pier would have been much diminished;—the deviation from the plan of Rennie, and its consequent ineffeciency entirely prevented;—that our harbour would have been more secure;—the debt now owing by the Commissioners would long ago have been liquidated; that a considerable reduction in our dues would have been effected; and that many improvements in our harbour would have been made, followed by an increase of our shipping, and, in consequence, to the revenues of our port. That such have not been the case, or at least to an extent worthy of a passing remark, may be attributed to the operation of our Harbour Act. The census of 1841 shewed that our population had decreased compared with the census of 1831, while, during the same period, in almost every town of Great Britain an increase had taken place. Now, how do we account for this? A navigable river for vessels of 400 or 500 tons' burden,—a coal field of great extent in the *immediate* neighbourhood, cheaper than in any seaport town,—an agricultural district around it, where the staple of our great manufacture is produced,—a population where wages are cheaper than almost any other town in the kingdom,—its situation easily accessible to all the east coast of England and Scotland, including the metropolitan towns of both,—situate opposite to those parts of the continent which furnish an important part of our textile manufacturers with supplies,—and without entering any further into detail, we find that our town has actually retrograded: all these conditions must bring us to the conclusion that it must be our local administration that has caused the whole.

It was not until 1838 that almost any manufacture of note was established in Berwick or its immediate neighbourhood. An iron foundry had existed since 1800, but it was confined to little more than the local demand, its annual exports to London or the outports seldom exceeding 200 or 300 tons. At that period (1838) I erected an iron work or foundry on a much more enlarged plan, which gradually increased; so that its consumption of iron in the year ending June, 1845, was little short of 5000 tons,—coals, coke, loam, &c.. &c., being nearly equal in amount. Other iron works followed, all of which are on the south side of the Tweed. Seeing that my manufactory was daily rising into importance,—that the difficulty and inconvenience of landing the materials used in the works, which were overlooked while they were of small amount, became of no small importance to a large manufactory, urged on by others who suffered the same inconveniency as myself, I set myself to work to consider all the bearings of the harbour, the constitution of its government, its Parliamentary Act, and the influence which that Act, and the mode in which it had been carried out, had had on the trade and prosperity of the town. To my mind they were so far from being satisfactory to the community; they presented so great a bar to all sort of improvement;—offered so little encouragement to industry, the extension of trade, manufactures or commerce;—the general system was of that close, concealed description, the reverse of everything open and undisguised;—the Commissioners, entirely free of any control from the public, meeting any application to them with civil, though frigid refusals;—the large sums that we were called to pay to these Commissioners, without any adequate return for them; all these considerations determined me to make an effort to obtain, not compensation for what had been so long unjustly exacted from us in former years, but better and *fairer* terms in those which were to come.

The grounds of our complaint were twofold:—The first was, that the schedule of dues, payable on

APPENDIX C.

BERWICK.

No. 71.
Guthrie, on the Proceedings of the Harbour Board.

all goods imported or exported by any party, were partial and unjust; that is, that one article of less value, less bulk, and less weight, was chargeable with dues of double, treble, and quadruple the amount of other goods of greater value, more bulk, of greater weight. The second ground of complaint was, that merchants, traders, and manufacturers on the south side of the river, (that is, the side of the river opposite to Berwick,) although they were subjected to the same dues, had literally no wharf or quay accommodation for the landing or shipping of their merchandise,—the whole of the south side of the river being a flat, marshy beach; and notwithstanding this, that they were saddled with the same local duties as their neighbours on the north side, who had quay accommodation at their doors. If the Honourable Commissioners of Tidal Harbours cast their eyes over a map of Berwick, Tweedmouth, and Spittal,—the former being situated on the north, and the two latter on the south side of the Tweed,—they will perceive that the population is nearly equal on both sides; that the manufactories where heavy materials are used are almost exclusively placed on the south;—that there is *no* quay or wharf accommodation on the English side; and that the average distance between the quays on the north side of the river is a mile from Tweedmouth and Spittal;—that there is a borough toll on the bridge exacting dues on all sorts of goods passing along it; and that there is a turnpike toll about 200 yards from the end of the bridge. The most prominent evil of which the inhabitants of the south side have to complain is, the distance they have to cart their goods from the quay on the north, to the warehouses on the south side, and the tolls they are required to pay; or, if they discharge or land cargoes on their side of the river, they can only do so for a few hours of the day, during low water, and then only over a soft and muddy sand, which prevents horses from dragging more than half a load. Now, I rest this part of my case on the facts I have just named. They require no explanation. Any intelligent stranger (nay let him be stupid, ignorant, or even prejudiced, or let him have lived in a borough town all his life,—and that is worse than all the qualities combined) must at once perceive the gross injustice of the case; and that I have not over-coloured the picture must be admitted by all. And if to this we add, that at Spittal many thousands of vessels, 1½ miles distant from any quay accommodation, have discharged their cargoes, and having boats innumerable during a long succession of years upon a beach, the same probably as it was in the time of Adam, and all paying the same dues to the port as if they used the wharfs, it must be at once conceded that they are unfairly and ungenerously treated.

The applications for the erection of a jetty or wharf, which the inhabitants of Spittal made to the Commissioners, having entirely failed to produce anything more than a road to the "Carr Rock," (a sort of minor pier almost useless for any purpose,) and which, from being built too near the shore, no vessel can get near it, determined me to bring the whole matter before the public, through the proceedings of the town council, of which body I was then a member. Accordingly, on the 5th of March, 1844, I brought forward at that Board, a motion for a committee of inquiry into the affairs of the harbour,—a copy of all the proceedings arising out of which I now have the honour to enclose. They were reported in the "Berwick Advertiser," from which they are taken, and I believe they are substantially correct. As in their proceedings you will find the subject treated at considerable length, and embodying a good deal of statistical information, I shall do no more in this place than to draw the attention of your Honourable Commissioners to them, particularly to the case of the fishermen, as detailed in pages 15 & 16. That a box of white fish, haddock, cod, or herring, of the value of 5*s*., should pay more shore dues by one-third than a box of salmon worth 5*l*. or 10*l*.;—that a ton of salt, (used extensively by our fishermen,) worth 20*s*., should pay 20*d*. per ton, while corn and flour, and a hundred other commodities are chargeable with only nominal dues, are facts there given, which, I doubt not, you will put to a proper use.

The motion, as anticipated, was negatived by a majority of 8, that number being exactly the number of the Harbour Commissioners, who also were members of the town council, and voted against the motion for inquiry. The members of town council who were present on this occasion are enumerated in page 31; and I have put an asterisk against the names of the Harbour Commissioners;—from which you will perceive that the number is exactly eight. The refusal to grant any inquiry into the affairs of the harbour, with which the public were so much interested, and to which they contribute nearly 3,000*l*. a year, naturally took every one by surprise. "Why," they said, "do the Commissioners resist an inquiry into affairs over which they act only as TRUSTEES for ourselves? Were we not convinced that they were incapable of acting unfairly, we should suspect that they were personally interested in keeping everything secret. They certainly do present an annual account of our monies to the public; but these accounts keep us in the dark, as they are not in any way specific, and we cannot understand them. Why all this mystery? We think it ought to be cleared up; and *some day* an *inquiry* will certainly be instituted." Never was prophetic vision more exactly or sooner fulfilled! A Parliamentary Commission for the very inquiry, almost literally the same, of my motion, has been appointed. Her Majesty's Commissioners have visited almost every tidal harbour in Great Britain and Ireland,—most searching *inquiries* have been instituted,—and a Bill founded upon the result of those *inquiries* is waiting only for the sanction of Parliament to become the law of the land.

The last act of the drama is soon told, or rather the last scenes of a theatrical performance, which usually ends with a farce. The Commissioners (ours) were required by the Act of 1808 annually to "produce and shew forth a statement of accounts relating to the said trust," and at page 31 of the document enclosed, you will find a copy of one so "shewn forth," for the year ending the 12th July, 1844. This is a sample, a stereotyped edition (with only the trifling alteration of a few figures) of all its progenitors and successors for the last thirty-eight years. I will never forget the expression of honest indignation which the countenance of your Honourable Commissioner, Captain Washington, showed, when he looked at this precious document; and yet methinks his indignation was tempered with a feeling towards risibility. I have laughed at the drolleries of the first comic actors on the English stage, but the following real scene in the council chamber, which occurred immediately after the Commissioners' "Statement of Accounts" was "shewn forth," for quiet humour infinitely surpasses them all.

Proceedings of Town Council, 6th August, 1844.

"The Commissioners' "Statement" was now read. Dr. Edgar inquired of the town clerk for what purpose he had read that statement?

"The Town Clerk said the Commissioners were required by the Act of Parliament to render a statement of their accounts to the head guild; and as there was now no head guild, they forwarded it to the council in lieu of it.

APPENDIX C.

BERWICK.

No. 71.
Guthrie, on the Proceedings of the Harbour Board.

"Dr. Edgar said, The account may or may not be correct; and as it does not, from the manner in which it is drawn up, admit of the council ascertaining its accuracy, it amounts to a piece of regular humbug to read it."

Nothing could be more true—nothing more apposite than the sentiments of Dr. Edgar on the question before the meeting; and though there was one word not often heard by "ears polite," yet I question that, were you to search all the dictionaries ever published, you would find a term, "vernacular" or otherwise, more appropriate for the occasion.

The members of town council having expressed general dissatisfaction as to the mode in which the Account was drawn up, they agreed to obtain the opinion of an eminent barrister, as to whether the Commissioners could not legally be compelled to furnish a plain and intelligible statement. Counsel's opinion was against us; and the "Statement of Accounts" is annually "shewn forth" to the council, "*in lieu*" of the head guild, in all its ancient obscurity.

The only effect which my motion produced was, an increase in the number of Commissioners.. At page 19 of the proceedings arising out of that motion, you will find it stated that there were then only eight Commissioners comprising the Board, instead of eighteen; and I questioned the legality of their proceedings on the ground that their Act required the original number should be kept up. Shortly afterwards more Commissioners were appointed by the eight then in office; and their Board is now composed of, I believe, fifteen gentlemen, consisting of seven corn merchants, or connected with the corn trade; one sail maker; one wine merchant; and six others having no occupation, or being very slightly, if at all engaged in trade. The partiality of the selection is too obvious for remark; but, in speaking on this subject in the council, Mr. Robertson so well expressed the sentiments of the public, that I cannot refrain from copying what he said on that occasion. He (Mr. R.) felt constrained to advert to the proceedings of the Commissioners in reference to the late election of new members. In that election they had altogether disregarded the claims of the manufacturing interest in the borough to be represented at their Board; they had then extended the influence of a party already over-represented, to the exclusion of all whose interest in the good management of the harbour gave them an equal, if not superior right; they had not merely excluded ironfounders, but ironmongers. On this and other proceedings the public might well look with surprise, and therefore justify the proceedings included in the motion of Mr. Guthrie."

The Bill now before me, and which you mean to bring into Parliament during the next session, having for its object a complete reform of our tidal harbour management, is one I think, of the most pressing necessity, and calculated to do much good. As you have been pleased to desire me to make any suggestion concerning it, I trust you will pardon me in venturing to propose that the twelve Commissioners who are to be appointed for the management of our ports, should be popularly elected in the same way as the Municipal Reform Bill directs; and that their proceedings should be, if not public, at least open to reporters for the public press. In Scotland I believe this is done with good results. That these Commissioners should, to a certain extent, be under the control of a permanent Tidal Harbours Board in London, and I would recommend that three or more well-qualified engineers should make periodical visits, or at such other times when required, to every tidal harbour in Great Britain and Ireland; and that no improvement, alteration, or any sort of erection connected with the harbours, be undertaken without their concurrence. New schedules of shore, harbour, and tonnage dues should be prepared on such a scale that every party exporting or importing goods should pay their fair and just proportion to the revenues of the harbour. The framing of new schedules would be the most difficult duty that your Board would have to perform; and when executed in the spirit to which I have alluded, vast sources of injustice to the community would be abolished. Whether it would be advisable to insert a clause in your Bill, that the schedules of the various dues should be revised every seven or ten years, or at some other defined period, is a question of grave consideration; but when we know that the value of commodities is continually changing, that circumstances arise in many seaports that entirely alter their mercantile or manufacturing position;—that a schedule of dues which would be strictly impartial in 1851, might not be so in 1861,—I think that the insertion of such a clause would be desirable, and add to the efficiency of the Bill.

I will conclude my long letter with sentiments which are an echo of your own; that it is my fervent wish that you may carry your Bill speedily through Parliament,—which is one of deep importance, not only as involving the general benefit of the public and the protection of our commerce, but also the welfare of a large class of Her Majesty's most valuable subjects—the merchant seamen of this great maritime empire; and that it is my most earnest hope that you may be enabled to institute efficacious measures whereby our tidal harbours may be rendered more available to our commerce and manufactories, and more accessible in the hour of need.

I have, &c.,
ROBERT GUTHRIE.

To the Secretary of the Tidal Harbours Commission.

APPENDIX C.

BERWICK.

No. 72.
Robertson on the management of the Harbour.

No. 72.

Letter of ALEX. ROBERTSON, Esq., *relative to the Harbour of Berwick-on-Tweed.*

SIR, *Tweed Foundry, Berwick, 15th Dec.* 1846.

You did me the honour, on the occasion of your recent official visit to Berwick, to say, you would receive any information relative to the memorial which had been presented to the Harbour Commissioners, from the traders on the south side of the port, praying for proper quay accommodation, and I now the more readily avail myself of your obliging promise as, from the want of notice of your intended visit and inquiry here, I had not a fitting opportunity to lay before you the claims of the inhabitants of Tweedmouth, in particular, to have shipping facilities afforded to them on their own side of the harbour.

The port of Berwick-on-Tweed may be said to consist of the town of that name, and the populous villages of Tweedmouth and Spittal; the former lying on the north, and the two latter on the south side of the river. The respective population of each is about 9000, 2500, and 1500. Berwick has, as far as it goes, good quay accommodation; Spittal has a jetty (very insufficient for its trade), while Tweedmouth is wholly without quay, jetty, or any other landing accommodation whatever; and such of its inhabitants as are desirous of landing their goods on their own side of the harbour are obliged to do so upon the naked shore, with only half-tide work, or about six working hours per day.

The following TABULAR STATEMENT will afford a Partial View of the Extent, &c., of the TRADE of TWEEDMOUTH.

Names of Manufacturers, Traders, &c.	Description of Trade.	Number of Persons employed.	Description, extent, &c. of Imports and Exports.	Amount of Shore Dues for 9 months, 1st of January to 1st October, 1846.
J. & A. Robertson & Co.	Ironfounders	95	Imported in 9 months, 1st January to 1st October, 1846:— Pig-iron . . 1,000 tons. Coke . . 370 ,, Bar-iron, coals, &c. 300 ,, ——1,670 Exported same period:— Cast-iron goods . . 630 Total . . . 2,300 tons.	£. s. d. 70 14 7
Ramsay & Morris	Ironfounders	45	The information under this head not yet received.	
Border, Brewery, Co.	Brewers	..	Two establishments, one in Berwick, the other in Tweedmouth.	
G. & J. Patrick	Prussiate and colour manufacturers	16	This business has only been in operation a few months. There will be a large importation of potashes, rags, horns, &c.	
S. Riddle & Sons	Engine-wrights and forgemen.	40	It is not deemed necessary to go into particulars of the trade of these parties, but it is self-evident, from the nature of the respective trades, and the number of men employed, they would find great convenience in having good quay accommodation on the south side of the harbour.	
John Black	Boilermaker.	8		
George Lee	Boat-builder.	30		
Cuthbertson and Son	House carpenters, whitening grinders, &c.	10		

There are many other tradesmen in a smaller way of business, but who would, of course, share relatively in the accommodation of a quay. It may be also mentioned, that persons residing a few miles from the south side of the harbour would likewise participate in this advantage. For example, Messrs. Black of Ford Forge, very extensive millers, and spade manufacturers; farmers and country dealers, in landing manures, wood, tiles, slates, and shipping produce, &c. The owners of coal-pits on south side of the river are, I believe, in correspondence with you, and I have not therefore referred to the coal-trade, though one of such vast importance.

Added to the additional cost in transport, to the inhabitants of Tweedmouth, in landing their goods on the north side of the river, there is an ancient toll on the bridge, which levies a rate on goods brought over to Tweedmouth; but from this exaction the goods landed for Berwick are quite free.

No very accurate account can be given of the number of ships which, even under the adverse circumstances of landing the goods on the strand, discharge their cargoes on the Tweedmouth shore, but it is believed that it amounts to about 100 per annum. With proper anchorage for the vessels, and landing facilities for the goods, there would necessarily be a great increase of shipping at the south side of the river. Messrs. J. and A. Robertson and Co. alone would discharge, in pig-iron, coke, &c., about 60 cargoes ranging from 20 to 50 tons.

There is another and very serious light in which the matter ought to be viewed; the inducements to the traders in Tweedmouth, under the above circumstances, to carry their goods by railway; and were Messrs. Robertson, Messrs. Ramsay and Morris, and others, in self-defence, to make arrangements with the railways, not only would much of their trade be diverted from the port, but the grain-trade, losing the back-freights of pig-iron from Glasgow, &c., would to some extent be also turned into the channel of the railways. So much, indeed, have Messrs. Robertson felt the determined and culpable neglect, on the part of the Harbour Commissioners, of the interests of the south side of the port, that

APPENDIX C.

BERWICK.

No. 72.
Robertson, on the management of the Harbour.

they are now preparing to treat with the railway companies for the carriage both of pig-iron from Glasgow, and coke, &c. from Newcastle.

Besides a quay or quays at Tweedmouth, and additional landing accommodation at Spittal, the Harbour Commissioners ought to have made the shore between the two places passable at all states of the tide; and I believe this could have been done at, comparatively, a trifling expense at the time they were dredging the river. It will, perhaps, be scarcely credited, that many thousand tons of gravel, &c., removed from the bed of the river, were barged, at a considerable expense, a little beyond the mouths of the harbour, and there let fall into the sea, instead of being used, with a retaining wall, in the formation of a proper roadway for the use of the south side of the port.

It was asked by you, Who represented the south side of the river in the Harbour Commission? I replied, No one; and it was of course for the Commissioners present at the inquiry to explain the reason for this. The injustice to the trade of the south side of the river was made the more glaring about two years ago, when several new members were elected (by the then existing body), and no selection was made from Tweedmouth or Spittal. I may further state, that the only large manufacturing interest (iron-founding) in the port was, and is, wholly left unrepresented; while, on the occasion referred to, an addition was made to the already over-represented corn and salmon trades. I believe the two most lightly taxed (in shape of shore-dues) interests in the port. Indeed, the iron-trade was not allowed to have even an ironmonger at the board. The following I believe to be an accurate descriptive list of the present members of the Harbour Commission Board:—

1. J. M. DICKSON (*Chairman*), sailmaker and shipowner.
2. JOHN DEWAR, corn-merchant.
3. JOHN WILSON, in no business here at present; formerly connected with the salmon-trade. and a partner of the Tweed Bank.
4. JOHN CLAY, corn-merchant.
5. G. K. NICHOLSON, timber and corn merchant.
6. GEO. GILCHRIST, at present in no business; formerly a draper here.
7. ROBERT CROSSMAN, formerly a brewer here, but now resident in London, and in business there.
8. GEO. HENDERSON, corn-merchant.
9. THOS. HOGARTH, Lieutenant-Colonel in the army, in no business.
10. JAS. A. INNES, timber and corn merchant; *partner of Mr. Nicholson* (5).
11. JOHN CUNNINGHAM, a partner in a brewery (I believe), but not otherwise in business
12. PATRICK CLAY, corn-merchant, *partner with his father, John Clay* (4).
13. J. R. DUNLOP, bonedust manufacturer.
14. JAS. MARSHALL, grocer.
15. THOS. COCKBURN, wine-merchant.

The 15 are, I believe, with one or two exceptions, members of a company very extensively interested, as proprietors as well as lessees, in salmon fisheries in the Tweed.

I think it but a fair and candid course to send a copy of this letter to the Harbour Commissioners, in order that they may have almost a contemporaneous opportunity of forwarding to you their remarks on it. Begging you to excuse the great length of the communication,

I have, &c.,
ALEX. ROBERTSON.

Captain Washington, R.N.

P.S. Continuous and pressing engagements prevented me giving such early attention, after your visit here, to this matter as I could have wished.

As your personal inspection would point this sufficiently out to you, I have not remarked on the greater facilities afforded for an extension of harbour accommodation on the south than on the north side of the river; and it is well known that much inconvenience frequently occurs from the crowded state of the quay at Berwick. But it would seem that the Harbour Commissioners must think that the port is not only perfect in its accommodation, but quite sufficiently frequented by shipping, since they decline giving increased facilities or attractions for vessels to use the port. Indeed, there is, in a measure their own direct and written authority for this; for instead of being "up and doing" to preserve the carrying trade of the port as much as possible from the competition of the railways, they "deem it inexpedient to increase their present debt, by making any additional erections on the south side of the river, until it is ascertained what effect the present railways may have on the revenues of the harbour;" or, in other words, when, by their neglect, much of the trade of the port has been diverted into another channel, they will not have occasion even to provide further accommodation for what may be left, much less to busy themselves in endeavouring to enlarge the commerce of the good town of Berwick. Perhaps, however, a little of the intelligence, practical knowledge, and official pressure of a Central Board may enlighten, instruct, and stimulate our local authorities.

APPENDIX C.

BERWICK.

No. 73.
Revenue and Expenditure, 1842-6.

No. 73.

Return of Revenue and Expenditure for the Years ending the 12th July, 1842-46.

INCOME.	1842			1843			1844			1845			1846		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
Shore dues, inwards	955	18	6½	981	16	9	1011	14	7¾	1233	9	9	1316	12	4
Shore dues, outwards	972	9	6½	863	0	7½	1038	6	0¾	989	6	2	833	17	1½
Tonnage dues	718	17	0	707	19	2¼	665	14	4¾	842	5	8	781	6	4¼
Harbour dues	116	13	4	106	13	4	115	6	8	141	10	0	143	16	8
Ballast, inwards	50	10	1	47	10	10	104	10	5	49	18	4	42	10	8½
Ballast outwards	31	11	8	28	2	4	19	19	8	44	6	4	55	16	4
Crane dues	..			20	10	9	5	16	5	7	12	9	9	9	3
Hire of dredger and lighters	..			73	5	4	..			48	7	6	32	0	0
Old stores sold	..			3	17	0	..			3	4	0	..		
Interest on bank account	..			14	13	1	6	8	8	15	0	9	23	16	3
£	2846	0	2	2847	9	2¾	2967	16	11¼	3375	1	3	3239	5	0

EXPENDITURE.	1842			1843			1844			1845			1846		
	£.	s.	d.	£.	s.	d.	£.	s.	d	£.	s.	d.	£.	s.	d.
Salaries, rents, attorneys' and clerks' bills	403	5	4	424	2	5	441	8	4	475	4	6	445	7	8
Dredging	178	10	2	433	9	6	..			74	16	7	26	11	9
Materials and repairs	54	8	3	107	8	8	49	11	10	35	16	4	45	13	8
Pier quay light-house	1592	13	5¾	734	17	6¾	970	4	11½	783	18	1¾	741	12	2
New road at Spitta	..			160	12	9	..			..			..		
Blacksmith's shop and store	..			149	12	8	..			..			..		
Law expenses	..			..			..			..			67	5	11
Interest on borrowed money	555	19	8	557	0	0	549	18	0	608	0	0	481	0	0
£	2784	16	10¾	2567	3	6¾	2011	3	1½	1977	15	6¾	1807	11	2

Debt due on the 1st January, 1846, 12,025*l.*

GRANTON.

No. 74.
Walker, on the site for a new Pier.

GRANTON.

No. 74.

Report on the Improvement of the Port of Edinburgh, by JAMES WALKER, Esq., F. R. S., L. & E., *President of the Institution of Civil Engineers.*

GENTLEMEN, *Great George-street, Westminster, May* 25, 1835.

YOUR letter to me, dated 7th February last, informs me that the Duke of Buccleuch had recently had surveys and plans made by Messrs. Stevenson and Son* for a low-water pier, and eventually for a harbour, at Granton, near Newhaven, and that being desirous in a matter of such consequence to have the advice of more than one engineer, his Grace had directed you to apply to me. I therefore proceeded to Edinburgh early in April, and in my first conference with you, was informed that the Duke was desirous that my survey and report should not be confined to the consideration of the extent and method of forming works at Granton, but should embrace the more general question of the expediency of any works there at all, having reference to the general interests of the district, his Grace having no intention of undertaking a measure, unless it could be shown to be consistent with those interests; and being of opinion that the public and his private advantages were so identified that what was not to be a public convenience could not be profitable or prudent for an individual to undertake. That I might the better judge of this, you informed the clerks of the City and of the Leith Harbour Commission, and also, I believe, the magistrates of Leith, of the object of my visit, and of your desire, as the Duke of Buccleuch's agents, that such information as might be considered useful in forwarding the inquiry, should be furnished me. I was in Edinburgh a week after this, during which time no communication was made to me; but I have learned from my assistant, Mr. Hartley, who remained some time after me to complete the soundings and measurements, that the City had offered any information that might be required.

While in Edinburgh I received much detail from Mr. Crighton, who has had long experience and given great attention to the subject; also from a deputation of Leith gentlemen, and from Captain Dall, who tendered me, with, I believe, the sanction of the Commissioners, every assistance, and accommodated me with the Commissioners' steam-vessel, in which he accompanied Mr. Stevenson and me. Mr. Cubitt, Mr. Scott, and Mr. Anderson, have also, without my applying for them, kindly furnished me with copies of their plans and reports.

For the purpose of refuge, it does not appear to me that an artificial harbour is much required in the Forth, unless in the case of ships having sprung a leak, or being driven in storms with loss of anchors and cables. The Frith itself is a fine natural harbour or roadstead; in heavy gales from the east, ships can anchor for a time under the lee of Inchkeith, where the anchorage is good and the depth at low water generally exceeding 18 feet; or they may run up to the Hope above Queensferry, where there is ample depth and space; and from westerly winds the east of Inchkeith and the bay of Inverkeithing afford security. A ship driven into the Forth in distress, or taking refuge there, would not, unless under very peculiar circumstances, leave the deep water for a harbour, with even 14 feet at low water near the entrance, and a hazardous shore on each side of it. Mr. Ogilvy, who has been actively engaged in shipping for half a century, remembers but one case of wreck in the Forth above Leith, and this was about 30 years ago: it might have been the effect of ignorance or negligence, but even supposing it unavoidable, the rarity of the case proves the excellence of the roadstead.

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* See Supplement for Messrs. Stevenson's Report.

No. 74.
Walker, on the site for a new Pier.

Although nature has thus done so much, a very superficial acquaintance is required for ascertaining the very imperfect communication between this fine natural harbour and the shore, for the purposes of trade, or the fitting out of His Majesty's or other vessels. It may be useless to endeavour to trace, the various causes that have tended to prevent improvements of which there is so great a capability but the facts, as they are, require to be stated with a view to ascertain the remedy.

It has often been observed, that the gut formed by the discharge of the water of Leith, fixed the formation of a town to that place, and it was probably sufficient for the kind of trade and the vessels that frequented it, the long sands forming a breakwater, and vessels being so built as not to damage by grounding. It is perhaps to be lamented, that when the changes in shipping rendered the sands injurious, the site was not left to vessels suited for it, and a fitter situation taken, instead of large sums being expended in attempts to overcome natural obstacles. Had this been done, no one can doubt, I think, that the trade of the Forth would have been very different from what it now is. A contrary course has, however, been adopted: within the last half century, the most eminent engineers of the time have been consulted as to the best mode of improving the harbour, very large sums have been expended, and certainly great good has been done. The details and dates of those works and the engineers who advised them have been fully stated in Mr. Cubitt's report. The most important were by the late Mr. Rennie,* who planned and executed the wet dock, the most important appendage to the harbour, and the greatest ornament of Leith; the east pier has been extended by Mr. Chapman, the west by Sir John Rennie: the execution of all appears creditable. The exertions of Captain Dall, the present superintendent, have also been most usefully employed. I am informed, that in 1826, when he entered office, there was from two to three feet water on the dock-sill at low water, but that since the channel has been cleared and deepened, the sill is now frequently dry. For a century previous to 1826 the depth on the bar seems to have been without alteration.

The present capability may, I believe, be fairly stated thus:—that the channel of the entrance is dry at the low water of ordinary spring-tides; that at high water of spring-tides, say for about three days in each alternate week, a vessel not drawing more than 14 feet is almost sure to get up to the docks; that even with 15 to 16 feet there is a good chance, but some risk; and that during neaps 11 to 12 feet may be reckoned on. All these depths are confined to the top of high water; but as a ship has to get up to the lock before that time, to prevent the danger of her being caught by the ebb and grounding on the sill, the pier gauge very properly indicates six inches less water than the sill, and with heavy vessels great caution must be requisite.

The following scale of the draught of vessels, which is from the best authority, will show what the harbour and dock are capable of:—

A vessel of 200 tons draws	12 to 13 feet.
,, 300 ditto	13 to 16 ,,
,, 400 ditto	16 to 17½ ,,
,, 500 ditto	17 to 18 ,,
,, 600 ditto	18 to 19½ ,,
,, 700 ditto	19 to 21 ,,

according to the build: so that a vessel of 100 to 200 tons may almost be counted on for getting into the dock at high water on her arrival; if she exceeds that burthen, and approaches 300, she must wait perhaps a few days only, but it may be a few weeks, or she must unload part of her cargo in the roads, which is attended with expense and delay, particularly in rough weather, and she is subject to the same inconveniences in loading outwards. I have already stated that even this extent of accommodation is but of modern date.

Had the build of vessels and the leisurely way of navigating them continued as formerly, and had other ports remained in their ancient state, Leith might still have done its share of the increased business of the country. Vessels would have continued to come up and wait patiently for lighters and fine weather to unload them in the roads, or they would have been of so full a build as to be laid upon the sand without damage, or of such a draught of water as to make tolerably sure of getting into dock the first spring-tide; but now when the spirit of locomotion and competition is so much abroad, when a passage across the Atlantic is made literally in about the same time that one from Leith to London used to be, and vessels are of a sharp build to sail fast, but liable to damage by grounding, and when other ports are made to suit this new order of things, it is not to be wondered at that Leith should be stationary while they advance. And then the degree of accommodation is not rendered more tolerable by the lowness of the rates. Mr. Crighton has furnished me with some particulars of the charges, the complexity and number of which, as well as the amount, are objectionable. I have submitted the list to the gentlemen from Leith who met me at Newhaven, and they agreed to their correctness: they form so important a feature in this question that I think it right to state the details.

There are the harbour, the dock, and the shore dues.

The first are payable upon every vessel that breaks bulk in the roads, and sends but one package on shore between Figgate Whins, a mile and a half below, and Wardie Burn, the same distance above, the harbour. They consist of beaconage and anchorage, 1½*d.* per ton on four-fifths of the register tonnage; if above 40 tons, 2*s.* 6*d.* for berthage and flagage, which amounts on the average to nearly a halfpenny per ton more, and if she enters the harbour, the pilotage is 1*d.* per ton inwards and the same outwards. Thus the charges amount to 2*d.* per ton if the vessel remains in the roads not having taken a pilot, or 4*d.* if she has entered the harbour.

The dock dues are payable on every vessel entering the harbour of Leith, whether she uses the docks or not, but no vessel is liable to them for more than eight voyages in any one year. The scale of dues depends on the port from which the vessel brings her cargo, and partakes much of the system of exclusion, or at least preference, which was the fashion in former days.

	s.	*d.*	
On ships from Greenland and Davis's Straits	2	0	per ton.
From the West Indies, Africa, or Asia	1	8	,,
Mediterranean and America	1	4	,,
Baltic, Spain, France and Western Islands	1	1½	,,
Ports on the Continent not further south than Dunkirk, and not in the Baltic	0	10¾	,,
Ports in Great Britain and Ireland, except between Buchaness and Eyemouth, and in the River Clyde	0	8	,,
Buchaness, Eyemouth, and Clyde	0	4	,,

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* I have been informed that Captain Huddart, whose reputation is deservedly of the very first order, accompanied Mr. Rennie as his colleague on the occasion.

APPENDIX C.

GRANTON.

No. 74.
Walker, on the site for a new Pier.

The shore dues come next, and amount to 3$\frac{1}{3}$*d.* per ton on all goods imported or exported by a freeman of Edinburgh on his own account, and 6$\frac{2}{3}$*d.* on goods belonging to non-freemen, if from or to foreign ports, or ports out of Scotland. There is also levied with the shore-dues a duty of 1*s.* 1$\frac{1}{3}$*d.* per ton, called the merk per ton, on all goods not the growth of Scotland, imported into Leith, or discharged within the three miles of coast, which is applied towards the maintenance of the clergy of Edinburgh; also 1$\frac{1}{2}$*d.* per ton on all goods imported for erecting and maintaining the drawbridges; and 1*d.* per ton for the Leith Trinity House, a charity for poor seamen. Goods, therefore, not the growth of Scotland, or the property of an Edinburgh freeman, pay—

	s.	*d.*
Shore dues	0	6$\frac{2}{3}$
Merk per ton	1	1$\frac{1}{3}$
Pontage	0	1$\frac{1}{2}$
Prime gilt	0	1
	1	10$\frac{1}{2}$

If the ship's cargo be sent to more than six different consignees from any port in England, the shore dues and merk per ton are payable by the measurement of the cargo, at 2*s.* 1$\frac{1}{2}$*d.* per ton for eight barrels' bulk; and Mr. Crighton states that this principle of charging by measurement is extended to bulky goods not coming within the rule, by which the rate of dues on many descriptions of bulky goods has been raised from 1*s.* 10$\frac{1}{2}$*d.* to 4*s.*, and even 4*s.* 3*d.* per ton of 20 cwt.

Such accommodation and such charges cannot tend to the increase or encouragement of trade.

To say that the harbour is sufficient for the size of vessels frequenting it will, in the first place, be denied by the owners of the largest class of ships, but were it correct, it is only stating one of the effects of which the want of capability is the cause. I can see nothing in the nature of trade that should confine that of the Forth to smaller vessels than that of other ports. If in despite of the want of accommodation heavy vessels come into the Forth and have their cargoes unloaded into open lighters in the roads, there can be no doubt that with greater dispatch, greater security and less expense, the number would be increased. No port is more conveniently situated for the Baltic trade than the Forth, and I know that many ships in that trade are of too great a draught to enter the harbour. Again, with the Forth before it, a coal country around it, and a canal by which goods can be sent to Glasgow in 14 hours, and thence to Liverpool, the district round Edinburgh seems well suited for flax spinning and other manufacturing purposes, a subject that has lately engaged public attention. The flax manufacture is carried on to a great extent in Dundee, which has no canal behind it, and from which goods are said to take a week on the average to reach Glasgow.

Independently of the change that has taken place in sailing-vessels, which appear to require accommodation beyond what Leith can afford, steam-vessels have of late years sprung up: these require despatch more than any other, and this despatch it is which causes the great and increasing trade carried on by them. It was so late as 1820 that after a correspondence opened by Mr. Charles Wood, of Port Glasgow, I proposed to Mr. Turner, of Rooksnest, Surrey, and we to Mr. Watt, of Soho, and other friends, to attempt the passage from London to Edinburgh by steam; and in June, 1821, the *City of Edinburgh*, our first vessel, made her first passage, agents of the then shipping companies being certain of the failure of the attempt, and even the celebrated Mr. Watt, whom we consulted, not expressing more than a general opinion of the probability of success. There are now five or six vessels in the same trade, all of them of greater size than the *Edinburgh*, and all making their passages in shorter time. In some of them a sacrifice of speed is made by building them so that they do not suffer much by entering the harbour; the others, viz., the *Watt*, the *Soho*, and the *Monarch*, cannot ground without injury. Their cargoes and passengers are, therefore, put into open boats* a mile from the shore, the unpleasantness of which has been felt by all who have travelled by the steam-vessels; females in particular complain that they sometimes suffer more annoyance between leaving the vessel and landing than on the passage from Blackwall to the moorings off Newhaven. In very rough weather passengers cannot embark or land—hence irregularity and delay; and they frequently remain on board until the morning, whereas, could the vessel have come to a pier or dock on her arrival, they might have landed and got to Edinburgh the preceding night. When there is not water in the harbour, the other companies' steam-vessels are liable to like inconvenience, and they must either wait for high water to enter or land their passengers by boats, their vessels paying the dock rates in addition to the harbour and shore dues. The passengers to and from the Fifeshire coast are subject to the same kind of annoyance, but less frequently, as the ferry steam-boats draw less water. The only crossing for horses and carriages being at Queensferry, and causing a circuit of many miles, is also an evil that ought to be remedied.

The treatment of goods by the London steamers is little better than that of passengers. I happened to be at Newhaven pier when some goods were being landed from the *Monarch*; the style of doing the work, and the accommodation for it were more like the running of a smuggled cargo upon the beach than the landing from what is now the principal conveyance for passengers and light goods between London and Edinburgh. For such as it is, Mr. Hamilton, the company's agent, informs me that he paid upwards of 600*l.* for the boatage of goods and passengers in 1834, 200*l.* to the ferry trustees for the use of Newhaven pier, and, as the vessels anchor in the roads, about 160*l.* for beaconage, anchorage, and berthage; in addition to which, as their cargoes were unloaded at a point eastward of Wardie Burn, they were subject also to the city charges, viz., the shore dues, the merk per ton or minister's charge, the pontage and the prime gilt, which average 6*l.* each trip, or about 400*l.* for the season.

I am not prepared to say if the reduction of the charges or increase of facilities would open a coasting trade in coal or any other minerals of the district, but the expense now attached to stone, if it may be taken as an example, amounts almost to a prohibition. The large blocks for the new columns of Blackfriars Bridge come from Craigleith, one of the finest freestone quarries in the kingdom, if not the very finest; they are carted through Edinburgh to Leith Harbour, the only shipping place, where they are put on board by the Commissioners' cranes and men: the cartage costs 4*s.*, and the shore dues, cranage, and shipping, 2*s.* more, making 6*s.* per ton, exclusive of port charges on the vessel.

Such, then, are some of the facts as respects the accommodation for the trade of all the world with Edinburgh and the district of which it is the port; and whatever difference might exist as to the nature and extent of improvement, it seemed, I may say, universally agreed that some increase of accommodation, particularly for large steam-vessels, is indispensable. You and the parties generally who take an interest in the question, know the various plans of docks and harbours that have been proposed: it cannot be useful to extend this report by the detail of them or their particular

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* I am told that this is likely to be partially remedied by having a steam tender.

No. 74.
Walker, on the site for a new Pier.

merits, or otherwise, in an engineering point of view. Great pains have evidently been taken by the different engineers in the preparation of plans, and the reports and estimates that accompany them.

The chief question in reference to extended accommodation seems to be, whether the addition should be made to the present harbour and docks, or separate from them, at some point where the deep water approaches nearer the shore.

The main argument in favour of the former plan is, that it would uphold or increase the value of the present docks, warehouses and property in Leith, but that a deep-water harbour or pier in any other place would produce the contrary effect, by affording better public accommodation than the present. A long experiment founded on this very argument as the basis of proceeding has been made, and the results of it are now to be seen. There has been great outlay, which has proved unprofitable, hence a heavy debt; but still the accommodation is insufficient, the charges high, the monopoly continued, and the effect of all these evils is the depressed state of the port, and of the trade of the district that has been described. Is any important change likely to take place by the proposed plan of a new harbour, with an entrance to the present docks from the westward, and is this, under existing circumstances, the most advisable plan for immediate adoption? I would observe, in the first place, that in all the plans now suggested, the idea of improving the present entrance seems almost to be forgotten, and that of a new entrance from the west into deeper water substituted. This plan was proposed by the late Mr. Rennie; modifications of it have since been suggested by Mr. Cubitt and Mr. Anderson; the general argument applies to all of them.

I think it will be agreed, even by the engineers and patrons of this scheme, that but for the supporting of the present property and system, none of the plans would have been recommended; that another situation would have been preferred, where the deep water is nearer the shore, so that much of the artificial excavation and the future expense of dredging would be saved, and where probably the charges would be lower than could be afforded were 150,000*l*. or perhaps 200,000*l*. added to the present debt. I much question the policy of this almost forced measure upon the interests, the protection of which is its avowed object. That a heavy addition will be made to the already large debt is certain, unless indeed the debt be considered as a gift or grant, which, from what I have lately seen in another more national harbour business,* there is little chance of. Will the additional rates pay more than the interest of this, after deducting the expense of maintaining the depth at the entrance and in the basin, and other charges? If there be a doubt, it deserves consideration. Mr. Cubitt's plan goes only to nine or ten feet water at the site of the entrance; the addition is to be obtained by dredging; and the being able to support it and the artificial depth in the harbour without great expense is, to say the least, problematical. The late Mr. Rennie planned a dock on the west of the present one,† but I have not been able to obtain a copy of his report, and therefore cannot state positively what he proposed as the depth at the western termination, unless by judging from the present depth at the site of his entrance, which is, I see, only three feet under low water; and this leads me to doubt if Mr. Rennie contemplated the capability of making and preserving so great a depth as Mr. Cubitt has supposed. Steam-vessels not being in use at the time, depth at low water was, to be sure, less necessary than at present.

The apprehension entertained as to Leith is, that a new or rival scheme would injure its trade: the calculations are founded upon a certain tonnage being to be loaded or unloaded, and that whatever is taken to another harbour is *pro tanto* a deduction from Leith, and therefore injurious to the property in it and to the security of the money advanced by the Treasury. This principle, it must I think be admitted, offers but indifferent security for any further loan; but besides this, the argument is opposed to the general interests of the port and the accommodation of trade, for it will be allowed, I presume, that these would be promoted by any convenience for landing, even if it had not the advantage of lower rates; if lower, so much the better. I would take an extreme case, and suppose what the public would like best, namely, an additional pier or harbour, with lower rates. It by no means follows conclusively that the trade, or even the revenue, of Leith would be diminished in the way that has been supposed; might not the accommodation and the low rates so increase the trade and the shipping as to produce a contrary effect? When Brindley was asked in the House of Lords, what chance the Duke of Bridgewater had of being compensated for his outlay, when the whole of the river trade to Manchester would not pay the interest of the estimated cost of the proposed canal, he replied, that he "expected the canal would make its own trade." The result has justified his foresight, and every new conveyance since has also created a trade for itself: the last was the Liverpool and Manchester railway, which, it is well known, was strenuously opposed by all the canals, and yet each canal now carries more goods than before the railway was opened! To descend to a smaller scale of illustration, it is said, that the owners of stage-coaches in London make larger profits, now that opposition has obliged them to convert their coaches into omnibusses, and to charge half or a third of the old fares, than when the monopoly existed. The very small number of vessels in Leith harbour, when I was there, looked very like the slow-coach system, and I have no doubt of a great increase by good accommodation and a lower and simpler scale of rates. I have been told, that Baltic and other goods are taken to Grangemouth, thence conveyed to lock No. 16 on the Forth and Clyde canal, and carried back to Edinburgh by the Union canal, at a lower rate than if they had been landed at Leith; and a deep-water pier below Grangemouth, which is spoken of, would tend to increase the accommodation for heavy vessels there. The communication from the Clyde to Edinburgh, already great, is on the increase, and the intercourse by canals has been improving more rapidly since an Edinburgh and Glasgow railway was projected. I am informed also that, to avoid the rates, cargoes from small vessels are sometimes landed below the Commissioners' boundary, with risk and inconvenience.

Notwithstanding these facts, my opinion is, that injury may be done by attempting too much in too great a hurry; that it will be well to proceed by degrees, but that time should not be lost before something is done, and that the first thing wanted is a pier in deep water, to which heavy steamers might come at all times of tide, and having landed their passengers and cargoes, go off to the roads, to come alongside again to reload; heavy vessels might also lighten at the pier, so as to be able to enter the dock. I would propose a T shape, and for economy, expedition, and the avoidance of an objectionable interference with the tide, so as to cause deposit, would recommend the work to be of cast-iron piles, or timber coppered under low water, the framing of the deeper part, from the shore outwards, to be left open at first for the free current of the tide, and the cross-head to be filled in with rubble stone,

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* Dover.

† It appears to me that deeper docks, with an entrance to the westward, as proposed by Mr. Rennie, would be a more useful appendage than a harbour in which a heavy ship or steamer could not lie afloat at low water.

APPENDIX C.

GRANTON.

No. 74.
Walker, on the site for a new Pier.

to nearly the high-water level, so as to form a breakwater. Though the cross-head be so filled up, or even built of stone, the objection to causing deposit will not apply as it does in the direction of the tide. The principal reason for the construction I have described, is economy, and that vessels lie better alongside an erection of this kind than a solid stone pier, is proved by experience. The pier and head are supposed to be not less than 35 feet wide, and the head 1,000 feet long, the latter being all in deep water, say 12 to 14 feet at ordinary spring tides. In moderate weather, steamers might lie on both sides of the head; there is space for four of the largest class on each side, and from the head towards the shore there is a length of 1,500 feet, with from 4 to 12 feet of water. An opening near the head, with a bridge, would enable vessels to pass to either side of the pier in case of a sudden shift of wind, without going round. Cranes would be fixed for the quick unloading of the steamers, and one or two powerful ones for the engines and boilers. A shed warehouse would also be required for passengers' luggage and goods, as the object would be to unload as much as possible when the vessels are afloat.

The communication with the opposite coast would be materially improved; passengers might land or embark at the pier at all times of tide, and with a proper landing-place on the opposite side, the convenience for the crossing of carriages and horses would, by saving distance, be very great. In case of the present points on the Fifeshire side being found insufficient for the landing and shipping of carriages, I am informed there are excellent situations with deep water close to the shore at Hawk Craig, to the eastward of Aberdour House, which is nearly opposite Granton.

I have heard and read various statements of the advantages and disadvantages of Trinity, Newhaven, and Granton, as the site for an improvement. The two former are nearer the centre of movement in Edinburgh than Granton, which again is nearest the Union Canal Basin, and the probable termination of a Glasgow railway, if carried into effect. Granton is also nearest the deep water, and less exposed to silt up: I have had soundings taken, which prove Messrs. Stevenson's correctness in this, and their statements to me have throughout been confirmed by the facts. Granton is nearer the islands higher up the Forth, but as comparative danger on that account appears to me out of the question, it had better not have been named; and the distance between Trinity and Granton is not such as to make the superiority of the roads, or mooring ground, in front of the former, supposing them to be so, of much consequence to steam-vessels.

Granton, being westward of Wardie Burn, is beyond the corporation boundary, and therefore exempt from the rates. I conceive this to be, perhaps, the most decided argument in its favour, for it will exempt the steam-vessels from part of their present charges.

In the accompanying plan, the various designs by different engineers are shown, and also the pier now proposed by me, if erected at Granton from the Ox Craig, and also, if as an extension of the present pier at Newhaven. The works described would amount to from 50,000*l.* to 60,000*l.*, which is about half what the same size of pier would cost in solid masonry. It would be done in less time than any other plan, and give effectual relief to the steam trade.

The Duke of Buccleuch might be remunerated by a small tax on passengers and goods landed at the pier, and by bringing his Granton estate into play, and with a moderate outlay, the convenience would, I apprehend, be such as to yield a fair return, but I have not materials for a calculation of this. Should his Grace consent to the measure, the heavy outlay by Government or the city would be unnecessary, for the present at least; the effect of the better accommodation upon trade would be proved, and a judgment would be formed of the expediency of further works, whether by the Dock Commissioners or the Duke, while the pier I have proposed, if executed at Granton, would not be in the way of any future improvement to the eastward.

Will the Leith interests object to this plan as taking the trade from them? I think they ought not. It is forced work to take large steamers into the harbour, and but for the Shipping Company having smacks and buildings there, probably their steam-vessels would remain in the roads notwithstanding all the inconveniences. It should also be considered if this would affect the property, particularly towards the harbour and eastward, so much as a new harbour opening from the west, and carrying the trade generally in that direction, and also if the new entrance might not tend to the neglect of the old one in its present state, and to comparative indifference as to its further improvement. To say the least, there would be two interests and the expense of two establishments.

Again, is the hope of further improvement of the present harbour desperate? It is allowed to have been deepened three feet within the last 10 years by dredging and other means; a further addition of three feet would be a most important improvement, but I do not think that such a depth, if made, would be maintained without occasional dredging. It is admitted, however, that this will also be necessary to preserve the depth proposed by Mr. Cubitt at the western entrance.

That the general movement of the sand is westward seems proved by the relative levels on the east and west side of any pier or projection. Newhaven pier was built about 15 years before Messrs. Dall and Leslie's soundings, and these show a difference of from 18 inches to two feet between the two sides. It is desirable therefore to keep the sands on the east of Leith Harbour from getting to the westward into the entrance, and a causeway is now being carried out from the pier head to the Mortella Tower to effect this object; this will go to lessen the expense of dredging, and should the breakwater designed by Mr. Cubitt be made, it will be the more necessary, as the effect of that work, extending out as proposed, will rather be to stop any sand moving to the westward, which will then rise on the east side, and tend to increase the expense of dredging at the entrance of the harbour.

After a consideration as full and impartial as I have been able to give the subject, and being fully aware from my own conversations with the Duke of Buccleuch that his Grace's feelings are the same as you described to me, I really can see no way in which a remedy to the present defects can be applied so economically, so expeditiously, and with so little interference with existing interests and rights as the measures I have stated. Whether the Duke will agree to such a work must depend on himself, but I feel assured from what I have seen that an expression of a wish on the part of the City of Edinburgh would have weight, and that it would be to the benefit of the inhabitants of that city and the district round it, I have no doubt. It might perhaps be difficult to convince the Commissioners or the City creditors that the effect of reducing and simplifying, and equalizing the rates, would improve their revenue, but this is evidently required along with the works I have proposed, whether executed at Granton or Newhaven, to give fair play to the trade of the port. That an increase of trade would be the consequence, is certain, and even in point of immediate revenue, I think the experiment worth trying.

I am, &c.,
JAMES WALKER.

To Messrs. Gibson and Home, W.S., Agents to his Grace
the Duke of Buccleuch, K.G., &c., &c., &c.

Appendix C

Granton

No. 76

Abstract of Exports and Imports.

No. 76.

Abstract of the Exports and Imports at Granton Pier, in the Years 1843-4-5-6.

Name of Company.	Ships employed	Voyages	Tonnage in and out	Tonnage paying Dues.	No. of B B† Outwards.	No. of B B† Inwards.	Horses.	Carriages.	Cattle	Sheep.	Dogs	Tons of Coal	No. of Tiles.	No. of Boxes of Fish.	Qrs. of Grain	Tons of Water	No. of Visitors.	No. of Passengers Landed and Embarked.
1846																		
General Steam Navigation Company	8	79	84,581	42,329	59,422	45,596	209	41	54	2,010	187	..		..	.	149	..	6,777
London and General Shipping Company	8	92	87,129	37,998	59,370	32,870	70	29	90	2,115	87	2,188	..	..	.	139½	..	5,488
Aberdeen, London, and General Shipping Company	4	177	100,538	80,138	48,158	17,871	288	54	2,185	18,510	737	.		6,823	1,119	8	.	23,544
Dundee Passage	1	229	59,151	14,068	19,477	26,058	262	38	5,171	5,927	188	..	..	..	.	49½	..	48,754
Stirling Passage	2	625	57,240	2,400	.	.	..		.		..			.	.		.	82,062
Montrose Passage	1	18	8,054	1,512	93	62	4	..	527	527	..	..	..	.	..	..	..	544
Fife Ferries*	..	..		.	..	..	..	..	-	..	.	.	..		..	..	..	..
Newcastle Passage	1	59	7,949	5,775	28	72	5	..	3	..	12	..	..	..	..	..	..	3,409
Hull Passage	.	..		.			..	..		.	..	..	.		..	..	.	.
Berwick Passage	1	38	3,259	2,280	83	8	..	..	8	116	..	.	.		..	..	.	1,038
Coal	16	282	16,022	..				..	..	..	.	21,568	..		..		..	
Total, 1846	32	1,579	398,913	156,520	181,617	122,555	838	160	8,086	29,205	1,211	23,766	..	6,823	1,118	345¼	27,057	171,616
Total, 1845	78	1,679	508,568	219,122	188,630	128,977	794	289	8,058	32,518	1,314	20,095	.	14,321½	115	528	25,123	164,768
Total, 1844	87	1,684	410,390	166,403	167,197	112,463	585	149	6,723	21,907	1,138	17,528	2,000	11,380	781	1,024	27,561	130,826
Total, 1843	89	1,787	411,242	141,200	87,144	66,979	551	210	4,101	30,780	877	16,060	6,000	4,388	2,597	608	22,278	124,343

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* Fife and Mid Lothian ferries, formerly between Kinghorn and Newhaven, transferred to Granton and Burntisland, 12th September, 1844.

† B B equal 1 ton.

Appendix C.

Borrowstowness.

No. 76.
Return to Order, 9th August, 1844.

BORROWSTOWNESS.

No 76.

Return to Order of the House of Commons of the 9th August, 1844.

Borrowstowness, February 21, 1845.

Sir,

In reply to your Parliamentary letter of the 1st current, requesting certain information regarding the port or harbour of Borrowstowness, I beg leave to state that I have never seen or heard of there being any plans of the port or harbour here, and the complaints being all verbal, there are no copies to transmit; but the harbour has often been found fault with as being in rather a ruinous condition, arising from the want of trade to this port. The harbour is of very easy access, but has had but little trade since the opening of the great canal at Grangemouth, which is within five miles of this. The Acts of Parliament under which the trustees for town and harbour have hitherto acted, are as follows; viz., 17 Geo. II., cap. 21; 7 Geo. III., cap. 90; 34 Geo. III., cap. 91; 56 Geo. III., cap. 36; and lastly, anno sexto et septimo Victoriæ Reginæ, cap. 69. The above are the particulars.

I am, &c.,
George Henderson, *Clerk*.

To the Hon. Manners Sutton.

No. 77.
Return of Income and Expenditure.

No. 77.

Income and Expenditure of the Town and Harbour of Borrowstowness for the Years 1842-44.

Income.	1842	1843	1844	Expenditure.	1842	1843	1844
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Impost on ales .	3 0 0	4 10 0	..	Interest on debt .	74 12 0	89 8 0	88 16 0
Anchorage duty .	127 3 2	153 7 9½	245 19 1½	Repairs on harbour	62 4 7	83 10 9½	86 17 1½
Assessment on houses . .	60 0 0	60 0 0	97 12 1	Repairs on streets	19 2 7	58 5 2	87 11 1
				Repairs on wells and water . .	20 9 4	7 7 4	..
				Charges of management . .	31 0 1	42 13 9	..
				Paid to account of new act . . .	..	383 19 7	832 3 8
£	190 3 2	217 17 9½	343 11 2½	£	207 17 7	665 4 7½	1095 7 10½

Debt due on December 31, 1845, 2400*l*.

Grangemouth.

No. 78.
Return of Income and Expenditure.

GRANGEMOUTH.

No. 78.

Return to Address of the House of Commons of the 29th July, 1844.

Canal Office, Port Dundas,
Glasgow, December 4, 1844.

Sir,

In obedience to the order of Sir James Graham, communicated in your letter of 20th ultimo, I now transmit herewith a statement of the revenue and expenditure of the Port of Grangemouth, for the years 1841, 1842, and 1843, respectively.

The dues are levied under the authority of the Forth and Clyde Navigation Act, which received the Royal Assent, 21st June, 1841.

Income.	1841	1842	1843	Expenditure.	1841	1842	1843
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Shore, harbour, and wharf dues . .	501 15 6	719 1 6	1160 13 2	Collecting dues .	26 3 2	37 11 0	50 0 0
Lamp dues . . .	19 15 0	29 6 6	47 11 0	Harbour master .	70 0 0	70 0 0	70 0 0
Crane dues . . .	1 12 11	2 12 2	3 17 1	Repairs	7 6 9	4 0 7	22 17 3
				Gas for lamps . .	50 0 0	50 0 0	50 0 0
	523 3 5	751 0 2	1212 1 3		153 9 11	161 11 7	192 17 3

I am, &c.,
William Crichton.

The Honourable H. Manners Sutton.

No. 79.
Return of Income and Expenditure of Pollok's Wharf.

No. 79.

Return of the Income and Expenditure of Pollok's Wharf for the Years 1841, 1842, and 1843.

Income.	1841	1842	1843	Expenditure.	1841	1842	1843
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Harbour dues .	22 11 6	7 3 2	18 2 2	Commission at 7½ per cent. collecting dues . . .	2 18 1	0 18 0	2 3 6
Wharfage dues .	14 5 9	4 5 5	9 12 1	Lighting & expense of lamps	2 12 6	2 3 6	2 19 0
Lamp dues . .	1 12 6	0 10 6	1 5 6	Repairs	..	1 5 0	1 6 6
	38 9 9	11 19 1	28 19 9	£	5 10 7	4 6 6	6 9 0

Dues levied under authority of Act of Parliament, obtained by the late Lord Dundas.

Pollok Gilmour & Co.

Appendix C.

Stirling.

STIRLING.

No. 80.

Return to Order of the House of Commons of the 9th August, 1844.

No. 80.
Return to Order 9th August, 1844.

Council Chamber, *Stirling*, *March* 31, 1845.

I.—Prior to the year 1843, the shore or harbour of Stirling, on the river Forth, was under the management of the provost, magistrates, and town council of the burgh, in virtue of Charters from the Kings of Scotland in their favour; and especially a Charter under the Great Seal by King Charles I., confirming all the prior rights belonging to the burgh, of date the 17th day of November, 1641.

II.—On the 27th day of June, 1843, an Act was passed, 6 & 7 Vict., cap. 47, intituled "An Act for improving and regulating the Navigation of the River Forth from Alloa to Stirling, and Works connected therewith; and for other purposes relating thereto," by which the management of the harbour of Stirling and the river Forth, from Stirling to Alloa, was vested in a commission, consisting of the provost, magistrates, and town council of the burgh of Stirling, and two commissioners of supply from each of the counties of Stirling, Perth, and Clackmannan, to be elected by the commissioners of supply of these counties respectively, at their annual general meeting on the 30th of April. And since then, the harbour of Stirling has been under the management of these commissioners, under the name of the Commissioners of the Forth Navigation.

III.—A report of the state of the harbour and river was prepared by Mr. Robert Stevenson, civil engineer, Edinburgh, in the year 1828, with relative plan and sections, and was revised by Messrs. Robert Stevenson and Sons in the year 1838; and upon this report the provost, magistrates, and town council of Stirling proceeded, when they went to Parliament to obtain the above Act. A copy of the said report and relative plan, and also a copy of the Parliamentary plan are sent herewith.

IV.—I am not aware of any complaints made to the magistrates, town council, or commissioners, relative to the defects of the harbour of Stirling.

William Galbraith, *Town Clerk.*

No. 81.

No. 81.
Stevenson, on the best means for improving the Forth from Alloa to Stirling.

Mr. Robert Stevenson, C.E., *on the best means for improving the river Forth from Alloa to Stirling, with Estimate.*

Edinburgh, November 26, 1828.

The Firth and river Forth are navigable for the largest class of merchants vessels, as high as the port of Alloa; and in spring tides, vessels drawing 9 feet water may proceed to Stirling, lying ten and a half miles above Alloa, while those drawing 7½ feet water may reach the mills of Craigforth, five miles above Stirling.* The improvement of the navigation between Alloa and Stirling has long been regarded as a desirable object, and was brought under the notice of the Reporter by the magistrates of Stirling in the month of November, 1825, when it was proposed to petition Parliament for leave to bring in a Bill for this measure. But it having afterwards been found advisable to delay till another session, the Reporter was left to proceed more deliberately with his survey, and having some time since completed it, he now reports as follows:—

The first step taken in this measure, was to make a nautical survey of the river, from which the accompanying map or plan was made. A level-line was traced from Alloa pier to Stirling shore, on which numerous points were fixed and worked, by stakes driven into the ground along the margin of the river; and in this manner the longitudinal and transverse sections† upon the plan were determined. A correct register of the operation of the tides was made from time to time, by means of graduated tide-gauges, to which glass tubes were attached for accuracy in observation. These tide-gauges were placed under the charge of attendants at different stations upon the level-line, by whom simultaneous observations of the rise and fall of the tide were made. The soundings, or depths of water, were likewise ascertained very generally over the bed of the river. The direction of the current is also shown by arrows; those drawn in red colour indicate the direction of the flood tide, and those in black, that of the ebb, or current of the river.‡

The channels proposed to be cleared through the different fords, are coloured red on the plan, in reference to the sectional line. For the use and guidance of river pilots, buoys and perches or beacons, are likewise intended to be placed in the positions shown in the plan; those coloured red are to be taken on the starboard, and those coloured black upon the larboard side, in going up the river; and the whole are to be so placed in connection with the clearing and deepening of the fords, as to be approached with safety.‡

Observations were made on the perpendicular rise and fall of the tide, and the results are given in the form of diagrams, which are delineated on the plan. The perpendicular lines are divided as a scale of feet, and form ordinates to the tidal curve, giving the heights at Alloa, Tullibody, Powis Hole, and Stirling, the chief places of observation; and the horizontal spaces on the diagrams represent the distances between these stations. The waved lines, coloured blue in the one diagram, represent the forms assumed by the surface of the water during the ebb, at the end of every successive half hour, as measured from the level-line traced upon the ground and marked as the top-line of the diagram; and the waved lines in the other diagram exhibit the successive states of the surface of the water during flood. The most anomalous result of this investigation occurs at Powis Hole, where the undulating surface of the water is considerably higher than the maximum rise of tide at Stirling and Tullibody, and even somewhat higher than that of Alloa. This effect seems to be analogous to the intermitting swells called the leakies and settles of the tide, which are known to occur on the Firth of Forth, about the commencement of flood tide, and which are noticed by the late eminent Professor Robinson in his *Mechanical Philosophy*. Such irregularities seem to have a connection with the narrow and tortuous tracts of the river, compared with the more direct and capacious form of the Firth below. These

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* A survey of the upper part of the river was made by the Reporter, at the desire of Mr. Drummond of Blair-drummond, and Mr. Smith of Deanston.

† The transverse sections are necessarily omitted in the annexed plan, from the smallness of the scale.

‡ These arrows and beacons are omitted in the annexed plan.

No. 81.
Stevenson, on the best means for improving the Forth from Alloa to Stirling.

diagrams are valuable, as showing the parts of the river in which the tide is most retarded, and where it flows or ebbs most freely.

Care has been taken to leave the means of retracing, at any future period, the level-line upon which the section is founded; and for this purpose bench marks have been cut in various well-known places, such as the coping of Alloa pier, and Stirling quay. But as marks in such places are liable to be defaced, the Reporter has, in a note on the large plan in the possession of the town clerk, described the level of this line, in reference to that of the basement course of the parish church of Alloa, the basement of Tullibody House, the basement of Polmaise House, the basement of the ruin of Cambuskenneth Abbey, and the basement of the Episcopal Chapel at the southern end of the street leading from Stirling quay to the town, as ascertained by him in the course of his survey.

Above Alloa the river becomes very circuitous. By the navigation the distance from thence to Stirling is 10½ miles, while in a direct line it measures only 5 miles. It has been proposed to render the navigation of this part of the river more direct, by cutting through the Links, or peninsular necks of land, for which the track of the river is so remarkable. This would shorten the navigable track; but it would have a direct tendency to deteriorate the navigation below, as a great volume of the tidal water, which at present passes over and scours the lower banks four times in the twenty-four hours, would be cut off and diverted from its course. The cutting of the links and straightening of the river would also, in a material degree, interfere with vested rights of the proprietors of the banks, by depriving some of the benefit of a water communication, and destroying the valuable salmon fishery of others. This plan, therefore, though worthy of consideration, is, upon the whole, judged inexpedient in the existing state of things. The Reporter proposes to improve the present channel of the river by deepening it, and removing part of those numerous obstructions called fords, and he therefore now proceeds to describe in detail each of these obstructions, and the works which are considered necessary for their removal.

Between Alloa and Stirling there are seven principal fords, or shallow parts of the river, which form so many obstructions to the navigation. It is not believed that incumbrances of similar geological structure are to be met with in almost any other river in the kingdom. The Firths of Tay, Moray, Clyde, Solway, and the rivers Mersey, Severn, Thames, and Humber, have their peculiar tides and difficulties, both in the form of rocks and sandbanks, but none of the channels are impeded by successive chains of imbedded stones and rocks, appearing at low water, like those called the Fords of Stirling. Various hypotheses have been started to account for the existence of these fouls; some have supposed them to be artificial, arising from stones having been thrown into the shallowest parts of the river at an early period, to render it fordable for cattle; but from the minute examination, which the progress of this survey has enabled the reporter to make, he has no hesitation in stating that they are natural barriers of rocks traversing the valley of the Forth, and are what geologists term *whin-dykes*, which, from the continued scouring of the bed of the river, have assumed the irregular appearance now presented by them at low water. Similar formations of whin or greenstone rock occur on the southern face of the Abbey Craig, and also on the northern side of Stirling Castle. The fords, like the cliffs at these places, consist of stones, varying in size from a cubic foot to a cubic yard, imbedded in a matrix of friable rock. The joint effect of the crooked channel of the river, and the obstructions caused by the fords, produces a great retardation in the velocity of the flood, which, in the upper parts of the river is very sensibly less than that of the flood in the Firth, and travels at the rate of only *one mile in five minutes*. Although this retardation may be considered to be in part due to the operation of the river current, yet it is obvious, from its languor, that this cannot be the principal cause, and it is therefore to be sought for chiefly in the obstructions offered by the fords. On the days of new and full moon it is high water at Alloa pier at four hours and forty minutes; at Tullibody pier at five hours and ten minutes; at Powis Hole at five hours and ten minutes; and at five hours and ten minutes at Stirling shore or quay. The consequence is, that the tide does not attain its maximum height at these three last places until it has been ebb tide for half an hour at Alloa. It appears further, from this train of observation, that the perpendicular rise of spring tides at Alloa is about 19 feet 4 inches; at Tullibody, 16½ feet; at Powis Hole, 12 feet, and at Stirling, 7 feet 8 inches: while the corresponding rise of neap tides at these stations is respectively 14½ feet, 11½ feet, 7 feet, and 3 feet. There being, therefore, a rise of 19 feet 4 inches in spring tides at Alloa, and only 7 feet 8 inches at Stirling, the available depth at that place is less than it would have been had there been no rise on the bed of the river by 11 feet 8 inches. Before leaving the subject of the tides, it may be proper to remark that the maximum point of high water at Alloa Pier is 4 inches above the level of the high water at Tullibody pier, while it is 2 inches lower at Powis Hole, and 3½ inches higher at Stirling shore. Hence arises the peculiar form of the tidal curve, shown in the diagrams on the plan.

The great object, therefore, to which the Reporter would direct the exertions of the magistrates of Stirling, as conservators of the navigation of the Forth, is to the removal of the fords, which are the chief obstructions to the free passage of the tide waters. The advantage of deepening the bottom in the upper reaches of the river is obvious, as the natural effect of such a change is to permit the tide to flow over the lowered ridges at an earlier period of the tide, and thus to allow high water to take place sooner, before the tide below may have fallen to any considerable extent; while, at the same time, an increased depth is obtained. Vessels may then start from Alloa earlier in the flood tide, and reach the shallowest parts of the river near Stirling, at the top of high water. In this view of the method of improving this part of the navigation, it is very satisfactory to know that a navigable track through the whole of these obstructions may be formed at a comparatively small expense by the common and simple process of blasting with gunpowder, and the use of flats or lighters fitted with cranes and other apparatus. The Reporter will now describe in detail the extent of the operations he considers necessary at the different fords.

On the reach between Alloa and Throsk, he proposes that a buoy provided with suitable moorings should be laid down at the seaward extremity of the bank, on the eastern side of Alloa Island, about a quarter of a mile above Alloa pier. This buoy will be useful as a direction for avoiding an extensive spit of sand on either side of that island. On its western side a perch or beacon is to be erected as a further guide for that channel.

The commencement of Throsk Ford is about a mile and a quarter above Alloa pier. The channel on this ford is very shallow, and when the river is in its state of summer water it dries nearly all the way across; but as this part of the river has the advantage of a perpendicular rise of about 18 feet in spring tides, and 13½ feet in neap tides, the navigation is comparatively little impeded. On referring to the plan and longitudinal section of the river, it will be seen by the parts coloured red that little excavation

APPENDIX C.

STIRLING.

No. 81.
Stevenson, on the best means for improving the Forth from Alloa to Stirling.

is proposed here. A buoy, however, is intended to be moored in a central position to show the deepest water, and, as a farther direction, a perch is to be erected on the starboard hand. This perch will also serve to point out the proper channel for passing Tullibody Island.

Cambus Ford is about a mile and a quarter above Throsk. The bottom of the channel towards the lower end of this ford consists of large stones and roots of trees, and in its upper part large boulder stones appear above the surface at low water. The rise of tide at this ford is 16½ feet in spring tides, and 11¼ feet in neap tides. The navigable channel to be cleared measures about 500 yards in length, and 30 yards in breadth at the bottom. An average cutting of one foot in depth will give about 20 feet at high water of spring tides at this place. A perch is to be erected on the larboard hand, opposite Tullibody Yare or pier, and another on the starboard hand, to the westward of the mouth of the Devon. By this means vessels will be enabled to avoid the foul ground at the bank on the opposite side of the river. The track of Cambus Ford is so obvious that it is not considered necessary to moor a buoy to point out the deepest channel.

Bandeath Ford is about three quarters of a mile above Cambus. Its bottom consists of two irregular lines of boulder stones, crossing the bed of the river with numerous detached masses of the same description. From the winding direction of the channel of this place, the navigation is rendered more difficult than at either end of the fords below; and, in clearing it, considerable works of excavation will be required. In spring tides the rise of the water, at the lower end of this ford is 16 feet 6 inches, and at the upper end 13 feet 4 inches; there is therefore a fall of 3 feet 2 inches, on a length of about 1150 yards, which occasions a rapid at low water, when the river is in its summer state. In neap tides the rise is about 11 feet 2 inches at the lower end; and 8 feet at the upper end. The length of the channel intended to be excavated at this ford is about 666 yards, and its breadth will, as already proposed, be 30 yards at the bottom. An average depth of cutting over its whole extent of about one foot will be required in order to give a depth of 18 feet at high water of spring tides. A perch is to be placed on the larboard hand at the lower end of this ford, and a buoy at the upper end. A perch must also be placed at Fallin Point on the larboard hand. In passing Polmaise and Scobbie's Pow no difficulty occurs; near Bannockburn, however, there is a bank where a perch will be required as a direction for the deepest channel.

Manor Ford, about two miles and a quarter above Bandeath, has an irregular and stony bottom. At the lower end of this ford, the rise in spring tides is 13 feet 8 inches, and at the upper end 12 feet 6 inches; and in neap tides about 8 feet and 6 feet 10 inches respectively; there is consequently a fall at low water of 14 inches, which occurs on a length of 666 yards, and produces a considerable rapid at this place. The extent of ford proposed to be cleared measures about 666 yards in length, and the breadth and depth of the channel to be formed will be the same as that already specified. This will require an average cutting of 18 inches in depth. From the curved form of this channel, a perch will require to be laid down on the larboard side, for each end of the ford, and a buoy must be moored in a central position on the starboard hand.

The Sow Ford is about three-quarters of a mile above the Manor Ford; the bottom is stony and irregular, and its direction also forms a curved line, but as the bottom presents fewer obstructions to the current than the two fords immediately below, there is no visible rapid at this place. Spring tides here give a rise of 11 feet 9 inches, and neap tides 6 feet 9 inches. It will be seen, on referring to the plan and section that the works of excavation of Sow Ford are not extensive. Instead of mooring buoys to point out the direction of the deepest water, it is proposed to erect two perches, the one on the starboard and the other upon the larboard hand. Wherever perches can be introduced they are considered preferable to buoys, which are more expensive both in their first cost and future maintenance.

The Abbey Ford is situate about a mile above the Sow Ford, and has already been excavated to a limited extent, with a view to its improvement; but the excavation wants extension, both in breadth and in depth to render it useful. The current here is so much obstructed that it causes a considerable rapid when the river is in its summer state; the fall being no less than 2 feet 6 inches on an extent of about 500 yards. Spring tides rise, at the lower end of this ford, 11 feet 6 inches, and at the upper end only 9 feet; and neap tides rise 6 feet 9 inches at the bottom, and 4 feet three inches at the top. The length of excavation will be about 565 yards, similar to that of the other fords. The average depth of excavation, in order to obtain 13 feet at high water at spring tides, will be about 2 feet. Connected with this ford, two buoys are proposed to be moored on the larboard hand, the one at the lower, and the other at the upper extremity of the ford; and a perch must also be erected on the starboard hand.

The Town's Ford is situate about 500 yards above the Abbey Ford. The foul ground at this place extends about 1,000 yards in length, and the works of excavation, in obtaining a navigable track, similar to that of the other fords, will be proportionably more extensive. Spring tides rise only 7 feet 8 inches at the Town's Fords, and neap tides about 3 feet. Its bottom is very irregular and rocky, forming a great obstruction to the trade of the town, and the navigation of the upper parts of the river. The average depth of cutting at this ford will be 2 feet. For pointing out the deepest water of the new channel, which it is intended to excavate, three buoys upon the larboard hand are considered necessary.

The results of the operations which the Reporter has described will be to deepen the river at those points where the obstructions occur; and the depths which are intended to be obtained at high water of spring tides are as follows at the various fords, viz.:—

Throsk Ford	22	feet.
Cambus Ford	20	„
Bandeath Ford	18	„
Manor Ford	16	„
Sow Ford	15	„
Abbey Ford	13	„
Town's Ford	13	„

By thus proportioning the depths at high water on each ford to its distance from Stirling, it is expected that vessels drawing 13 feet will have sufficient water over the lower fords at any period of flood, and will thus be enabled to reach Stirling at the very top of high water, and get the full advantage of the most favourable time of tide in the shallowest parts of the river.

The shore, or quay of Stirling, extends 200 feet or thereby along the right bank of the river, and consists of a breast-wall built in a rude manner with boulder stones, without the usual and necessary

APPENDIX C.

STIRLING.

No. 81.
Stevenson, on the best means for improving the Forth from Alloa to Stirling.

provision of defenders or wooden stretchers to prevent vessels from receiving injury while lying at their moorings. Vessels must consequently lie off in the stream to the great inconvenience of the mariner and trader. In any improvement, therefore, upon the navigation of the river, the unserviceable state of the quay-wall at Stirling should not be forgotten; but measures should be taken for rebuilding it, at least to some extent. The accommodation on this wharf is also very circumscribed and defective, but it may easily be extended and improved, as proposed to the magistrates by the Reporter some years since. The road from the shore should also be formed on a more easy line of draught. It would likewise prove a great convenience to the southern parts of the town and the lower districts of the county, if an additional wharf, and a road from thence, were formed about the central part of the Town's Ford; as also proposed in the report above alluded to. In conclusion, the Reporter has to state as the general result of his inquiry, that it appears, from the annexed estimate, that by an expenditure of about 10,126*l.* 4*s.* the fords of the Forth might be cleared, so as in spring tides to admit the passage up to Stirling of the ordinary class of merchant vessels drawing about 13 feet water; and he cannot but think the importance of such an improvement far outweighs the capital required for its attainment. The position and rising importance of Stirling are too obvious to be longer neglected. It is the natural emporium of the western highlands, and lies in front of an extensive and fertile district, containing many valuable waterfalls and other facilities for the establishment of large manufactories.

I am, &c.,

To the Provost, Magistrates, and Council, Stirling. ROBERT STEVENSON.

Abstract Estimate of the probable Expense of the Works of Excavation, mooring Buoys, and erecting Perches or Beacons in the several Fords and Reaches, on the River Forth, between Alloa and Stirling, agreeably to the foregoing Report.

	£.	s.	d.
For the expense of works of excavation and removal of stuff, and for mooring a buoy and erecting a perch connected with the reach between Alloa and Throsk	72	1	0
For works of excavation, &c. at Cambus Ford	618	18	0
Do. do. Bandeath Ford	654	13	0
Do. do. Manor Ford	918	7	0
Do. do. Sow Ford	439	10	0
Do. do. Abbey Ford	1,787	16	0
Do. do. Town's Ford	2,747	5	0
For works of masonry and for re-building and extending Stirling quay	1,200	0	0
	8,438	10	0
Incidents on the above sum of 8,438*l.* 10*s.* at 20 per cent.	1,687	14	0
	£10,126	4	0

No. 82.
Memorial of the Forth Navigation Commissioners to the Lords of the Treasury.

No. 82.

Memorial of the Forth Navigation Commissioners to the Right Honourable the Lords of the Treasury.

The humble Memorial of the Commissioners of the Forth Navigation,

SHEWETH,—

THAT the navigation of the Forth between the royal burgh of Stirling and Alloa is greatly obstructed by several fords or shallows in the channel of the river, by which in certain states of the tide, vessels of even the smallest draft of water are prevented from passing up and down the river.

That the improvement of the navigation by the removal of these obstructions has long been a matter of deep interest to the community, and at various times surveys and reports by professional men have been obtained by the magistrates of Stirling, in regard to the best mode of accomplishing that end.

That in the year 1828 a survey and report were made by Mr. Robert Stevenson, civil engineer, and in the end of the year 1838 another investigation was made by Messrs. Robert Stevenson and sons, which resulted in an Act being applied for and obtained in the year 1843, for improving the navigation in the terms of the recommendations contained in the report of the Messrs. Stevenson, and for this purpose constituting the magistrates and town council of Stirling, and two commissioners of supply from each of the counties of Stirling, Perth, and Clackmannan, the "Commissioners of the Forth Navigation."

That power was given by the Act to your memorialists from time to time to borrow money, in all to the extent of 15,000*l.* for carrying the purposes of the Act into effect; but although they have made many attempts to do so, they have hitherto found it impossible effect a loan, except to a very limited extent, in consequence of your memorialists having no security to offer for the money borrowed, except the rates leviable under the Act.

That the capabilities of the river are very great, and the present obstructions to its navigation are such as could be removed with little difficulty, as the engineers of your memorialists are prepared to shew.

That as your memorialists understand the Tidal Harbours Commission is now sitting, they are induced in the circumstances in which they are placed to crave that the Commission may make inquiry into the circumstances of the case, with a view to such assistance or advice being granted as may be thought proper.

And your memorialists therefore humbly pray that your Lordships will give instructions to that effect.

GEORGE GALBRAITH, *Provost of Stirling,*
Chairman of the Commissioners.

Stirling, May 31, 1845.

APPENDIX C.

STIRLING.

No. 83.

Substance of the Evidence of Mr. WILLIAM GALBRAITH, *Town Clerk of Stirling, before the Tidal Harbours Commission in* 1845. *Report, p.* 90.

No. 83.
Galbraith and Stevenson's Evidence in 1845.

A MEMORIAL has been presented by the Commissioners of the Forth Navigation, complaining that the navigation of the river between Alloa and Stirling is much obstructed by fords and shallows, and an application has been made to the Treasury, asking to advance money on the security of the rates. The revenue of the port is 350*l.* levied by dues on tonnage. Act of 1843 authorizes to raise 10,000*l.*, but only half of it till 5000*l.* has been expended on the improvement of the river. Have only raised 1600*l.*, the greater part expended in obtaining the Act. Vessels of 150 tons have reached Stirling at high water spring tides; wool, grain, and limestone form the chief trade. The only guarantee that can be offered as payment of the interest of any loan, are the rates authorized by the Act to be levied; those at present amount to 350*l.* a-year; on 5000*l.* being expended, these might in part be doubled, and thus produce 600*l.* a-year; on 4000*l.* more being expended, the full rates might be levied, or 850*l.* a-year; and thus, although there were no addition to the present traffic, ample funds would be available to pay 3 per cent. interest on 10,000*l.*, and to form a sinking fund of 400*l.* a-year for the redemption of the debt. Would gladly concur in any arrangement on the part of the Admiralty for improving the river. The shipping belonging to Alloa amount to 99 vessels, of 17,392 tons; to Stirling, 24 vessels, of 1048 tons; and 3 steamers. Arrivals and sailings at Alloa, 806; at Stirling, 526 yearly, besides 492 steam trips. Has tried in vain to borrow money from any public body or Scottish bank. Craig Forth Weir was granted by one of the Kings of Scotland to the then Lord Elphinstone, for his salmon fishing. The town of Stirling objected to it, but it was overcome. Has furnished a copy of the grant to the Commission.

Substance of the Evidence of D. STEVENSON, Esq., C.E., *before the Tidal Harbours Commission, in* 1845, *on the Improvement of the Forth. Question* 1771—1804.

HAS surveyed the Forth from Stirling to Alloa. There are seven fords, consisting chiefly of whin boulders; these should be removed, so as to gain 3 feet water up to Stirling; the depth is now 10 feet, it should be at least 13 feet at high water spring tides, and then vessels might reach Stirling in one tide. The cost of such works would be 9400*l.* nearly. Alloa and Tillibody Islands are surrounded by embankments, and there are several others which exclude the tidal water. Tide flows to the Cruive of Craig Forth, 4½ miles above Stirling, where it is impeded by a mill dam, against which it rises 4 feet. The distance by the river from Stirling to Alloa is 10½ miles; by land, 7½. The slope of the bed of the river between these two places is 11½ feet. Ordinary spring tides rise at Leith, 16½ feet; at Alloa, 19 feet; at Stirling, 8 feet. Is aware of embankments near Kincardine, but not of their extent.

No. 84.

Return to Address of House of Commons of the 29th July, 1844.

No. 84.
Return to Address of House of Commons of the 29th July, 1844.

Council Chambers, Stirling, March 31, 1845.

IT is impossible to state what the receipt of the harbour of Stirling is at present, or has been in time past. By Charters from the kings of Scotland, and especially one from Charles I., under the Great Seal, of date the 17th day of November, 1641, and by immemorial usage, certain dues, contained in a table of rates, dated 1st March, 1755, were levied by the magistrates and town council of Stirling, at the shore of Stirling, on the river Forth, called the shoremail and anchorage, the proceeds of which were applicable, and applied, not to the repairs of the harbour merely, but to the general purposes of the burgh. This shoremail and anchorage was let from year to year to a tenant, jointly with certain other burgh customs. And it is therefore impossible to state how much of the rent was derived from the custom called the shoremail and anchorage, and how much from these other customs.

The magistrates and town council of Stirling applied in the year 1843 for an Act for improving the navigation of the river Forth, from Alloa to Stirling, for improving the harbour of Stirling and the accesses leading thereto; and an Act was obtained, 6th and 7th Vict., cap. 47, (27th June, 1843,) incorporating the magistrates and town council, and two commissioners of supply from each of the counties of Stirling, Forth, and Clackmannan, by the title of "The Commissioners of the Forth Navigation," for carrying the purposes of the Act into execution. By this Act the town not only gave up to the commissioners the management of the harbour, but also abandoned the dues previously exigible by them, known by the name of shoremail and anchorage, and any other dues formerly exacted at the shore; and the Act contains schedules of rates according to which the owners of vessels are liable to pay to the commissioners for the vessels, and the goods and passengers conveyed thereby, *over any part of the navigation betwixt Alloa and Stirling, whether coming to the harbour of Stirling or not.*

For the year preceding 29th July, 1844, the harbour was under the charge of the said commissioners, and the dues on the navigation were levied by them, and certain monies were borrowed under the authority of the Act. For the other two years for which the return is required, the harbour was under the management of the magistrates and town council, who received the shoremail and anchorage dues above stated, and other dues let along with them, the several amounts of which are shewn as follows, viz. :—

Receipts.

				£	s.	d.
1841-42.—For shoremail and anchorage and other dues, levied by the Tacksman of said dues				140	15	0
1842-43.—Ditto ditto ditto				146	5	0
1843-44.—Rent for which the dues were let	£ 356	3	7			
Money borrowed on the security of the rates	1000	0	0	1356	3	7

APPENDIX C.

ALLOA.

No. 84.
Return to Address of House of Commons of the 29th July, 1844.

Expenditure.

		£ s. d.	£ s. d.
1841-42.—	Repairs made at the shore of Stirling		22 16 6
1842-43.—	Ditto ditto	£6 12 8	
	Payments made by the magistrates and town council to account of expenses of carrying through the Bill, while the same was in progress . . .	607 10 1½	
			614 2 9½
1843-44.—	Payments made by the commissioners to solicitors, engineers, and others, during this year, out of the monies received under the Act, relative to obtaining and passing the same	1026 1 0	
	Payments for erecting houses for levying the dues, printing, &c., certain repairs made at the shore	43 17 10	
			1069 18 10

Council Chambers, Stirling, March 31, 1845. WILLIAM GALBRAITH, *Town Clerk.*

Debt due on the 31st December, 1845, 1600*l.*

ALLOA.

No. 85.

No. 85.
Return to Order of the House of Commons of the 9th August, 1844.

Return to Order of the House of Commons of the 9th August, 1844.

AT a very early period, and prior to the year 1635, the Crown made a grant to the family of Mar, of "Burgum, portum marinum de Alway (Alloa) et Pau ejnsdem, cum privilegio, littoris et anchoragij, cimbis portatoriis et (lie) Ferries, super aquam de Forth infra bondas dominii de Alway."

In the 27th year of the reign of His Majesty King George the Second an Act was passed intituled "An Act for levying a Duty of two pennies Scots, or one-sixth part of a penny sterling, upon every Scots pint of Ale and Beer brewed for Sale, vended or sold within the Town and Barony of Alloa, in the County of Clackmannan, and also a Duty of Anchorage for Ships and Vessels anchoring at the Harbour of the said Town." By this Act the Duke of Argyle and certain other noblemen and gentlemen heritors of the county of Clackmannan were appointed overseers under the Act, and certain inhabitants of the town of Alloa were named trustees for carrying into execution the purpose of the Act.

Another Act was passed in the year 1786, intituled "An Act to continue and render more effectual so much of an Act passed in the 27th year of the reign of His late Majesty King George the Second as imposes a Duty on Ships and Vessels anchoring in the Harbour of Alloa, in the County of Clackmannan, for repairing the Pier of the said Harbour." By this Act the duties on ale and beer brewed for sale, and sold within the town and barony of Alloa, and also the duty of anchorage for ships and vessels granted by the first-recited Act, are declared to cease after the 1st of May, 1786, and in place thereof, an anchorage duty of three farthings per ton is authorised to be levied upon every ship or vessel upon her arrival at the said harbour in the town of Alloa, from and after the said 1st day of May. By this Act certain persons are nominated and appointed trustees for cleaning, deepening, keeping in repair, and improving the said harbour, and improving and repairing the pier, and also for putting in execution all other powers given by the said Act, which also declares that the money to be raised and collected by virtue of this Act shall be vested in the said trustees, and the survivors of them, and their successors. By another section of the said Act the surviving and remaining trustees, or any three or more of them, are authorised to elect, nominate, and appoint new trustees in the room of those who shall die, remove, or refuse to act. The trustees at present acting under the authority of the said Acts are Robert Jameson, sheriff clerk of Clackmannanshire; Robert Bald, engineer Edinburgh; Alexander Bald, merchant in Alloa; Jamie Mackie, accountant at the Alloa colliery; John Miller, coppersmith in Alloa; William Mitchell, merchant, Alloa; John Morrison, of Smithfield, near Alloa; and John Duncanson, shipbuilder in Alloa.

In virtue of these Acts of Parliament the harbour was greatly enlarged and improved, and a new pier, called the Central Haven, was built on the west of the old harbour, by which the ships and vessels resorting to the port were well accommodated. In order to defray the expense, the trustees were under the necessity of contracting 669*l.* debt, to enable them to pay which another Act was passed in the year 1803: the Act is intituled "An Act to amend an Act made in the 26th year of His present Majesty for the improvement of the Harbour of Alloa, for paving, cleansing, and lighting the town of Alloa, and other purposes therein mentioned." By this Act the trustees for the harbour are authorised and empowered from and after the 24th June 1803, to levy certain rates and duties contained in a schedule annexed to the Act, on all goods, wares, merchandise, baggage, parcels, or other articles whatever laden or unladen at the port of Alloa. The Act also confers more extensive powers on the trustees for improving the harbour. The other object of the Act is for paving and lighting the streets of the town of Alloa, and for supplying the inhabitants and also the ships resorting to the harbour with good and wholesome water. For these last-mentioned purposes, a separate set of trustees are named, who are authorised to levy certain rates on the proprietors and occupiers of houses within the town.

Subsequent to the year 1826 the trustees built a new stone pier on the south side of the east pier, by which a great additional accommodation for ships and vessels was obtained; and as it was necessary to widen that part of the harbour, and in contemplation at some future period, to erect wharfs, and build warehouses for the accommodation of trade, the trustees purchased from the Earl of Mar a piece of ground on the south side of the harbour, of which they obtained a grant or charter from his Lordship, which is dated 7th July 1836, a copy of which is also transmitted herewith.

Plans.

In the years 1825 and 1826 the trustees had it in contemplation, as already mentioned, to make some very extensive improvements on the harbour, and in particular to form a wet dock for the accommodation of the large ships and vessels employed in the North American trade belonging to the port of Alloa, and which in general lie there during the winter months. With that view they obtained from Mr. Robert Stevenson and Mr. Robert Bald, civil engineers, a plan and section of the harbour, showing the proposed wet dock, swivel bridge, lock-gates, &c., along with a written report and estimate;

APPENDIX C.

ALLOA.

No. 85.
Return to Order of the House of Commons of the 9th August, 1844.

a copy of this plan and of the report are herewith sent, and also of another plan of the harbour and ferry of Alloa, by the same engineers made in the year 1825.

It is proper, however, to mention that none of the improvements recommended by Messrs. Stevenson and Bald have been executed, except the erection of the stone pier on the south side of the east creek or pow, which extends from the mouth of the pow to the proposed drawbridge on the first mentioned plan. The ancient pier on the west of this creek or pow, has at various times been taken down and rebuilt, about a hundred yards of it last summer,—as well as the remainder of the piers from the mouth of the pow westward to the quay called Stein's Quay; all these are within the limits of the harbour, but the timber yard, building dock, and all to the westward until you reach the ferry pier, are the private property of the Earl of Mar or his tenants, and his Lordship also claims the exclusive right to the quay called Stein's Quay.

Complaints.

No complaints have been made to the trustees of any defects of the harbour. There is abundance of accommodation for all the shipping that usually resort to the port, or are likely to resort to it for some time to come.

The great evil which the trustees of the harbour of Alloa, and its public in general, have to complain of is the long-continued practice of shipmasters throwing their ballast into the Forth, on their passage up the river from Queensferry to Alloa and Stirling. This practice has prevailed to a considerable extent, and has greatly increased, since the extensive colliery on the estate of Clackmannan was established a few years ago. The coal from that colliery is shipped at the creek, about a mile and a half below Alloa, known by the name of Clackmannan Pow, which is daily resorted to by numerous ships and vessels engaged in the coal trade; and the constant custom of the shipmasters is to throw their ballast over their ship's side into the river; and though this pernicious practice, so injurious to navigable rivers, is expressly prohibited, under high penalties, by the Act 54 George III., cap. 159, sec. 11, yet no notice has been taken of the practice by the authorities either in Clackmanan or Stirlingshire.

The trustees of the harbour of Alloa did, indeed, interfere to prevent it. They employed two men to watch the river for some months in the year 1842, and at different times (both before and since); and a few convictions followed on prosecutions instituted by them before the Sheriff Substitute of Clackmannanshire. But these have not had the effect to put a stop to the practice, and the consequence is, that the sandbanks in the river have of late greatly increased, and new banks are forming; and the steam-vessels which ply daily betwixt Granton and Alloa and Stirling often run aground on these banks; and the passengers have frequently to be conveyed in small boats to the pier at Alloa.

Within these twenty years, vessels of from 60 to 70 tons burthen, with their cargoes could pass up or down the river, to and from Alloa, at low water, but now the passage of the river is so obstructed, that such vessels have difficulty to get over the banks, and must use great care to shun them almost at any time of the ordinary tides. The practice complained of is not confined to this part of the river only, it prevails to a fully greater extent in the neighbourhood of the harbour of Charleston, where great quantities of coal and lime are shipped, belonging to the Earl of Elgin. It is earnestly hoped that Government will interfere and adopt efficient measures to put a stop to this evil so injurious to all interests in this country. It would be attended with beneficial effect were the guarding of the river, with the view of detecting trespassers, put under the inspection of the different custom-houses on the Forth, and boats, with active hands, kept to visit the vessels on their arrival, as well as their progress up the river.

The foregoing return made by

ROBERT JAMESON.

No. 86.

No. 86.
Stevenson and Bald, on the formation of a Wet Dock, and Estimate.

Messrs. STEVENSON and BALD, *on the formation of a Wet Dock, and Estimate.*

Edinburgh, June 26, 1826.

IN the month of February last, the Reporters visited the harbour of Alloa, and met with Mr. Jameson and several of the trustees, when the present state of the harbour, and the means of improving it were respectively considered.

The quays and breast walls of Alloa harbour are in a very dilapidated state, and stand much in need of repair. When the improvements in view are undertaken, some alteration in the line or direction of the quays may be advantageously made, for the better berthage and greater security of the shipping of this rapidly extending place.

The Reporters, however, understand the immediate object of the trustees to be directed to the accommodation of the larger classes of vessels belonging to the port, the owners of which are obliged to lay them up at the neighbouring havens, because they cannot do this with safety at home.

After carefully examining this state of things, and considering the favourable depth of water, and rise of the tides at Alloa, which appear to range from 13 to 23 feet at high water of neap and spring tides, and taking into view the inconveniency to commerce from the interruptions incident to shipping berthed in a rapid current, and laid upon a bed of silt and mud without the advantage of quays, they have no hesitation in recommending the formation of a wet dock or basin as the most commodious and proper improvement for the general traffic of Alloa, and especially for the berthage of large ships during the winter months.

In reference therefore to the design exhibited in the accompanying plan and sections of an entrance lock, wet dock, and bridge of accommodation, laid down in connection with the large pow or creek at Alloa, the wet dock will be observed to take a southern direction from the long pow upon a tract of flat ground, every way suitable for such a work. The area included by the plan extends to three acres, but a chain of docks to any extent may here be executed piece-meal, or according to the wants of the trade. The proposed swivel bridge across the entrance lock may be for a time dispensed with by continuing a line of road between the saw-mill and the long pow.

By the annexed estimate, the wet dock, lined with masonry, amounts to *34,670l. 3s.*, while by the design in which the wet dock is only proposed to be partially lined with masonry, the estimate amounts to *20,076l. 16s.* In the present state of these enquiries, the Reporters consider it unnecessary to furnish specifications for the work, but they refer generally to the estimates as data on which the trustees may form calculations in providing the ways and means for carrying the operations into effect.

ROBERT STEVENSON.
ROBERT BALD.

APPENDIX C.

ALLOA.

No. 86.
Stevenson and Bald, on the formation of a wet Dock, and Estimate.

Estimate of the Expense of an Entrance Lock and Wet Dock, containing an area of Three Acres, for the Improvement of the Harbour of Alloa.

Entrance Lock.

		£	s.	d.
200	lineal yards of tunnel for carrying the waters of the saw-mill dam past the entrance lock, including excavations, puddling, and sluice, at 5*l*. 5*s*. per yard	1050	0	0
	Dam thrown across the creek for keeping out the tidal waters from the dock operations, including loss on timber	163	0	0
1,250	cubic yards of excavation in preparing the foundation of the side walls, and inverted arch, at 1*s*. per cubic yard	62	10	0
	Expense of pumping water, and other contingencies, at	150	0	0
1,635	cubic yards of face work in masonry of side walls, and inverted arches, at 2*l*. 2*s*.	3,433	10	0
2,501	cubic yards of hammer dressed masonry for backing walls, and rubble counterforts, at 10*s*. 6*d*.	1,313	0	6
	Extra in chain pits for opening and shutting gates, &c.	25	0	0
1,393	cubic feet of British oak for gates, at 10*s*. 6*d*.	731	6	6
2,080	superficial feet of 3-inch memel plank, for covering gates, at 1*s*.	104	0	0
176	superficial feet of 3-inch memel plank, in footway of gates, at 1*s*.	8	16	0
4	handrails on top of gates, at 2*l*. 2*s*. each	8	8	0
15,992	pounds of malleable iron work, in straps, clench bolts, and connecting-rods, &c. of gates, at 6*s*. per *lb*.	309	16	0
4	cast-iron sluices, faced with brass, at 12*l*. 12*s*.	50	8	0
4	screw boxes and bolts for working sluices, at 5*l*. each	20	0	0
64	cwt. of cast-iron work, in four segments, for gates and rollers, at 10*s*. 6*d*.	59	4	0
	Jagged spikes for covering gates, at	8	0	0
	Workmanship upon gates, including hanging them	210	0	0
8	cast-iron winch machines, complete, for opening and shutting gates, at 15*l*. each	120	0	0
1,984	lbs. of malleable iron, ⅝-inch chain, for connecting the gate and winch machines, at 6*d*. per lb.	49	12	0
	Incidents, estimated at 15 per cent.	1,194	19	6
	Total for Entrance Lock	£9,161	10	6

Wet Dock, lined with Masonry.

		£	s.	d.
154,170	cubic yards of excavation in Wet Dock, including puddling round the masonry, at 1*s*. per yard	7,708	10	0
	Pumping water, &c., estimated at	210	0	0
4,678	cubic yards of face work in masonry of docks, at 2*l*. 2*s*.	9,823	16	0
8,298	cubic yards hammer dressed masonry in backing, and rubble in counterforts, at 10*s*. 6*d*.	4,356	9	0
	Incidents, estimated at 10 per cent.	2,200	17	6
		£24,308	12	6
	Add expense of Entrance Lock, as estimated above	9,161	10	6
	Expense of cast-iron swivel bridge	1,200	0	0
	Total for Entrance Lock; Wet Dock, lined with masonry; and swivel bridge	£34,670	3	0

Wet Dock or Basin, lined with Masonry only at the Entrance.

		£	s.	d.
113,333	cubic yards of excavation, at 1*s*. per yard	5,666	13	0
	Pumping water, &c., estimated at	500	0	0
890	cubic yards of face work at entrance, at 2*l*. 2*s*.	1,869	0	0
1,517	cubic yards of hammer dressed masonry in backing and rubble, in counterforts, at 10*s*. 6*d*.	796	8	6
	Incidents, estimated at 10 per cent.	883	4	0
		9,715	5	6
	Add expense of Entrance Lock, as estimated above	9,161	10	6
	Expense of cast-iron swivel bridge	1,200	0	0
	Total for Entrance Lock; Wet Dock, lined with masonry at entrance; and swivel bridge	£20,076	16	0

Summary of Estimate for Wet Dock, lined with Masonry, &c.

	£	s.	d.
Expense of Entrance Lock, with gates complete	9,161	10	6
Ditto of Wet Dock, lined with masonry	24,308	12	6
Ditto of cast iron swivel bridge	1,200	0	0
Total	£34,670	3	0

Summary of Estimate for the Wet Dock, only partly lined with Masonry.

	£	s.	d.
Expense of Entrance Lock, with gates complete	9,161	10	6
Ditto of Wet Dock, lined partly with masonry	9,715	5	6
Ditto of cast-iron swivel bridge	1,200	0	0
Total	£20,076	16	

No. 87.
Return to Address of the House of Commons of the 29th July, 1844.

No. 87.

Return to Address of the House of Commons, of the 29th July, 1844.

Revenue.	1842.	1843.	1844.	Expenditure.	1842.	1843.	1844.
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
				Repairs to harbour . .	72 12 0	44 0 2	66 11 1
To rent of anchorage on ships and vessels, and shore dues payable on goods, let by auction	600 0 0	550 0 0	600 0 0	Expense of taking down and rebuilding pier of old harbour of Alloa .	..	..	600 0 0
				Cleaning harbour of mud and shorehead of rubbish, &c.	64 8 2	76 3 11	66 14 10
To rent of pavement yard . .	2 0 0	..	..	*Expense of Management* :—			
Interest of money .	32 12 0	41 16 8	31 19 2	Shoremaster's salary, 30*l.* Cashier's salary, 10*l.* 10*s.*	40 10 0	40 10 0	40 10 0
Received from Mr. A. Bald, value of a piece of wood not required for harbour . . .	..	0 2 6	..	Feu duty to the Earl of Mar, for ground purchased for enlarging harbour	18 6 0	18 6 0	17 15 6
To sum drawn from bank account . . .	..	..	288 0 10	Miscellaneous articles, including 24*l.* for watching river	55 8 4	64 2 3	39 14 8
				Sum paid to the trustees for the town towards the expanse of keeping in repair the highways and streets leading from the said harbour to the mill bridge of Alloa, in terms of the Act 43 Geo. III., cap. 55, *loc.* and *per.* . . .	100 0 0	80 0 0	104 0 0
				Sum paid into the bank account	132 12 0	287 8 0	..
				Income tax	..	5 16 1	5 16 1
	634 12 0	591 19 2	920 0 0		483 16 6	616 6 5	941 2 3

N B.—The anchorage is levied on all ships and vessels at the rate of three farthings per ton on the arrival of every ship or vessel in the harbour, in terms of the Act 26 Geo. III., cap. 13, and the rates and duties on goods are imposed by Act 43 Geo. III., cap. 55.

KINCARDINE.

KINCARDINE.

No. 88.
Return to Order of the House of Commons of the 9th August, 1844

No. 88.

Return to Order of the House of Commons of the 9th August, 1844.

SIR, *Tullyallom, February* 17, 1845.

IN answer to the communication of the 1st, relative to the harbour of Kincardine in the Firth of Forth, this harbour, or rather pier, was constructed by Lord Keith, in 1811, 1812, and 1813, under an act of Parliament, entituled "An Act for constructing a Pier or Harbour at or near the Town of Kincardine, in the County of Perth," in 1810. Lord Keith's trustees are now the proprietors.

There is no map or plan of the harbour; no report by engineer or others; and there never was any complaint of any defect or otherwise of the said harbour.

I remain, &c.,
WILLIAM MENZIES.

The Hon. Manners Sutton.

No. 89.

No. 89.
Return to Address of the House of Commons of the 9th July, 1844.

Return to Address of the House of Commons of the 29th July, 1844.

THE average income for the last three years for anchorage and shore dues, has been 20*l.*, the average expenditure on the same being for repairs on the breast-walls and wood-works, 5*l.*

Authority by Act of Parliament, 50 Geo. III., cap. 29.

SIR, *Blackwall by Kincardine, November* 20, 1844.

I WAS duly favoured with your letter relative to the harbour of Kincardine, and above is an answer to the queries therein contained. And

I remain, &c.,
WILLIAM MENZIES.

The Hon. Manners Sutton.

INVERKEITHING AND ST. DAVID'S.

INVERKEITHING AND ST. DAVID'S.

No. 90.
Correspondence relative to Address of the House of Commons of the 29th July, 1844.

No. 90.

Correspondence relative to Address of the House of Commons of the 29th July, 1844.

SIR, *Custom-House, Borrowstowness, May* 3, 1845.

IN obedience to the Honourable Board's Order of the 26th ultimo, No. 43, (a circular,) we send you inclosed an account of the total amount of the several dues and charges of every kind levied on shipping at this port in the years 1843 and 1844, with the exception of Inverkeithing and St. David's,

APPENDIX C.

INVERKEITHING AND ST. DAVID'S.

No. 90.
Correspondence relative to Address of the House of Commons of the 29th July, 1844.

which we have not as yet received. We are, however, informed that the proprietors of the said harbour decline complying with their Honours, said Order. We have again written to the officers at Inverkeithing, to send us an explicit answer to said Order from the parties concerned in said harbour.

We are, &c.,
MAL. M'GILVRAY, *Collector.*
J. SHEEHAN, *Comptroller.*

C. Scovell, Esq.

GENTLEMEN,
Custom-House, Inverkeithing, May 5, 1845.

WITH reference to your letter of the 3rd instant, we beg to state that on receipt of the Board's General Order, No. 43, 1845, we called by letter on the agents for the Earl of Elgin, the late Sir P. C. H. C. Durham, and the magistrates of Inverkeithing, to furnish us with the particulars required, in so far as their several harbours are concerned.

The answer from Charlestown was transmitted before it was half an hour in our possession.

As St. David's is a private harbour, the agent declines to furnish the account. Indeed he informed the officer that no answer would be sent; and as to Inverkeithing, we have not succeeded in getting any answer, though we have seen the authorities personally.

The agent at St. David's, and the magistrates of this burgh, did not enable us to complete the account required by General Order, No. 97, 1844, believing that it did not apply to their harbours, and they decline to furnish a similar account, in the present case, under the same belief.

We are, &c.,
R. MOFFAT, *Sub-Collector.*
ROBERT J. SCOTT, *Sub-Collector.*

The Collector and Comptroller, Borrowstowness.

SIR,
Custom-House, Borrowstowness, May 6, 1845.

WITH reference to our letter of the 3rd instant, we beg leave to transmit you inclosed a letter from the officers of Inverkeithing, by which it appears our former information as to the proprietors of the harbour of St. David's, and Inverkeithing declining to furnish the accounts required by General Order of 26th ultimo, No. 43, is well founded, to which letter we beg to refer you.

We are, &c.,
MAL. M'GILVRAY, *Collector.*
J. SHEEHAN, *Comptroller.*

C. Scovell, Esq.

ABERDOUR.

No. 91.
Return to Address of the House of Commons of the 29th July, 1844.

ABERDOUR.

No. 91.

Return to Address of the House of Commons of the 29th July, 1844.

Income.	1842.			1843.			1844.			Expenditure.	1842.			1843.			1844.		
	£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*		£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*
Gross Receipts . .	104	1	9½	109	0	6½	128	3	8	Collector's salary .	10	0	0	10	0	0	10	0	0
										Repairs of pier and cleaning harbour	64	16	5	35	3	3	3	0	11
											74	16	5	45	3	3	13	0	11

Dalmahoy, January 11, 1845.—I, factor for the Earl of Morton, hereby certify and declare that the above is a true and correct return, and that the authority under which the above sums are levied is a Charter under the Great Seal of Scotland, in favour of James Earl of Morton, dated the 31st day of March, 1704, and ratified in Parliament, conformably to Act of Parliament, dated the 14th day of September, 1705, and the successive subsequent renewals thereof contained in the titles made up in the persons of the successors of the said James Earl of Morton, and in the person of the present Earl of Morton.

GEORGE GLENDINNING.

BURNTISLAND.

No. 92.
Return to Order of the House of Commons of the 9th August, 1844.

BURNTISLAND.

No. 92.

Return to Order of the House of Commons, of the 9th August, 1844.

Burntisland, March 12, 1845.

1st. Charter granted by *King James V.*, dated 1541, whereby he conferred the right to the port of Burntisland, commonly called (Portus salutis) a *Port of Grace*, to the provost, bailies, council, and community of the royal burgh of Burntisland.

2nd. Charter granted by *King James VII.*, dated the 4th March, 1585, confirming the preceding Charter.

3rd. Charter granted by *King Charles I.*, dated the 9th February, 1632.

4th. Instrument of Sasine or Charter, by *Charles I.*

5th. Ratification by an Act of the Parliament of Scotland, conferring Charter No. 3, and Sasine No. 4, dated the 28th June, 1633.

And since these dates, by use and wont.

A plan of the town and port or harbour is herewith enclosed, which will show the extent of the port or harbour. It also might, at little expense, be made into a harbour of refuge, as vessels can take the harbour in any weather, and when in are in great safety.

JAMES HUTCHISON, *Town Clerk.*

BURNTISLAND.

No. 93.
Return to Address of the House of Commons of the 29th July, 1844.

No. 93.

Return to Address of the House of Commons of the 29th July, 1844.

Income.	1841.			1842.			1843.			Expenditure.	1841.			1842.			1843.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Anchorage . . .	79	1	5	94	6	7	90	19	4	Repairs . . .	7	17	8	29	11	7	18	15	0
Shore Dues . .	105	11	2½	113	13	5	90	5	4	Interest . . .	25	0	0	25	0	0	25	0	0
	184	12	8	208	0	0	187	4	8		32	17	8	45	11	7	43	15	0

Debt due on the 31st December, 1845, 500*l*.

N.B.—Charter granted by King Charles I. dated the 9th February, 1632, and Instrument of Sasine following therein dated the 27th July same year, and both ratified by an Act of Parliament of Scotland upon the 28th June, 1633, and continued by use and wont since that date.

JAMES HUTCHISON, *Town Clerk*

PETTYCUR.

No. 94.
Return to Address of the House of Commons of the 29th July, 1844.

PETTYCUR.

No. 94.

Return to Address of the House of Commons of the 29th July, 1844.

Income.	1842.			1843.			1844.			Expenditure.	1842.			1843.			1844.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Shore Dues on Goods, &c. . .	90	0	0	112	10	0	120	0	0	Repairs on the Harbour of Pettycur	..			..			16	2	4
Anchorage of Ferry Boats . . .	50	0	0	50	0	0	50	0	0	Balances applied in payment of the Interest on the Harbour Debts .	140	0	0	140	0	0	153	17	8
	140	0	0	162	10	0	170	0	0		140	0	0	140	0	0	170	0	0

The dues are levied under the authority of a charter of James V., of 30th August, 1541; and another charter of James VI., of 12th December, 1611.

The town has, besides, a claim of 15*l*. or 20*l*. for each of the above years for the shore dues of coals for steam vessels, the amount of which has not yet been ascertained.

Kinghorn, March 17th, 1845. THOMAS BARCLAY, *Town Clerk.*

KIRKCALDY.

No. 95.
Return to Order of the House of Commons of the 9th August, 1844.

KIRKCALDY.

No. 95.

Return to Order of the House of Commons, of the 9th August, 1844.

SIR, *Kirkcaldy, February* 7, 1845.

YOUR letter of the 1st of February, addressed to the town council of Kirkcaldy, has been handed to me.

In answer, I have to state—

1. That the harbour of Kirkcaldy is under the management of commissioners, appointed under an Act of Parliament, "which received the royal assent the 1st of June, 1829, intituled "An Act for the Improvement, Maintenance, and Regulation of the Harbour of Kirkcaldy, in the County of Fife."

2. I beg to forward a copy of "a Report to the Town Council of Kirkcaldy on the State of the Harbour, and on a Plan for its Extension and Improvement, by Mr. James Leslie, Civil Engineer, Dundee." dated the 20th November, 1839. Annexed to this report are plans of the harbour, with designs for its extension and improvement.

The only part of the improvements recommended by Mr. Leslie in the above report, which the commissioners have been enabled to carry out, has been the extension of the east quay the length of 300 feet, instead of 250 feet, as proposed by Mr. Leslie; and which they accomplished during the years 1843 and 1844, at an expense of upwards of 10,000*l*.

The commissioners have it in contemplation, so soon as the state of the revenue of the harbour will prudently admit of it, to carry out the remainder of the improvements recommended by Mr. Leslie; first, by the erection of a new west quay; and secondly, by the formation of docks, &c.

3. No complaints have been lodged with the commissioners.

I am, &c.,
JAMES RUSSELL, *Clerk to the Harbour Commissioners.*

Statement certified by PATRICK D. SWAN, *Provost* and Chairman of the Harbour Commissioners.

The Hon. H. Manners Sutton.

APPENDIX C.

KIRKCALDY.

No. 96.
Leslie, on the Improvement of the Harbour, and the Formation of Docks

No. 96.

Report by J. LESLIE, Esq., C.E., *on the Improvement of the Harbour and the Formation of Docks at Kirkcaldy.*

Dundee, November 20, 1839.

AGREEABLY to an appointment with Mr. Fergus, I visited the harbour of Kirkcaldy on the 26th, 27th, and 28th August last, and inspected the present state of the works, and made also a careful examination into the capabilities afforded by the site, for the improvement and extension of the harbour.

I have also had a correct plan and sections made of the harbour and its vicinity; and having met the gentlemen composing the Harbour Committee on the ground, and heard the suggestions offered by them and by the shore master, and having given the subject the fullest consideration, I now beg to report my opinion on the matters submitted to me.

The eastern pier is mostly substantial, and in a pretty good state of repair, especially at the outer end, of which a considerable portion is quite new; but the other piers, particularly the middle and the outer part of the western, are in a very dilapidated state; and, therefore, it is desirable that any new works should, if possible, be arranged so as to interfere little with the eastern pier, but rather to supersede or to afford protection to the western or middle piers.

The harbour of Kirkcaldy lies in a rather deep sandy bay, but is, nevertheless, much exposed to the swell brought up the Firth by gales between E.N.E. and S.S.E.; and as much inconvenience was experienced by the run in the harbour during such gales, the eastern pier was extended in 1823 so as to overlap considerably the west pier, and afford it shelter.

This has in some measure answered the proposed end, although it must be rather injurious in south-westerly gales; but it has also had the effect of raising up a sandbank at the west pier-head, which, however, is prevented from extending quite across the entrance by the influx and reflux of the tide, and by the scour at low water from the sluices in the gates of the small half-tide basin.

The east pier-head stands on ground about 5 feet above the level of low water of good spring tides. It is distant 500 feet from low-water mark, and is placed halfway up the beach, between low-water and high-water mark; and as the current of the tide past the harbour-mouth is very slow, and not of sufficient strength to remove any sand or other heavy matter deposited there, the scour from the basin, to be efficient in maintaining the necessary depth of the fairway, would require not only to carry the sand from the harbour outside of the pier-heads, but also to clear a channel through the sands at low water; and this, in its present state, it has not strength enough to perform effectually, and consequently, the fairway is neither broad enough nor deep enough for the passage of the larger class of vessels frequenting the port.

To secure, as far as practicable, the advantages sought for, namely, greater depth and facility of access, and greater safeness in the present outer harbour, and increased berthage and other accommodation, I consider it advisable to carry the pier-heads farther out towards low water than at present, and to increase the area of the harbour to about double its present extent; and I beg to submit the accompanying plans, whereon the designs for the proposed extension and improvement of the harbour are delineated in red.

The plan No. 1 shows the projected works, if completed to their full extent; and the nature of these works I shall now endeavour to explain.

In the first place, the eastern pier requires to be extended in its present direction about 250 feet, and a new western pier constructed, abutting on the shore, opposite the Coal-wynd, so as to take advantage of that opening for the purpose of shipping coals, and for other objects of trade; and after proceeding outwards about 220 feet, nearly at right angles with the beach, this pier will bend to the eastward and proceed for 380 feet in the direction of the east pier-head, leaving an opening for an entrance between the two heads of 75 feet in width.

An inner quay of 280 feet in length, will then be built parallel with, and at the distance of 220 feet from, the new east pier, so as to connect the new west pier with the old west pier near the present entrance of the basin.

The space outside of this quay, and having an area of $1\frac{1}{2}$ acres, is proposed to form an outer harbour, which may be available for vessels lying in during quiet weather, and will serve for the waves to expend their force in during easterly gales, and thereby afford shelter to what is now the outer, and will become the inner harbour; and the space inside of this quay, between it and the shore, and including a portion of the present basin, will be formed into a wet dock of nearly $2\frac{1}{4}$ acres.

The inner portion of the old west pier will require to be removed, as it comes within the area of the proposed dock, and the outer arm may either be repaired and suffered to remain of its present dimensions, or a new and broader quay may be built in its place; but as the inside face of it is in a very shattered state, I think that at no distant time it will be necessary to take it down and rebuild it.

The present middle quay may stand for a time with some repairs; but when it comes to be rebuilt it would be advisable to widen it to the eastward, as shown in the plan, so as to take in a small portion of the area of the present harbour; and, when additional berthage is required, a new quay may also be built on the north side of the harbour which will thereby be reduced in area from its present size of $2\frac{2}{3}$ to $2\frac{1}{3}$ acres.

On the space between the new middle quay and the street, and also occupying part of the present area of the basin, a very convenient site will be procured for a graving dock, entering through the wet dock; and owing to the bottom being rock, it may be constructed there very economically.

The possession of a graving dock would be attended with very great advantage to the shipowners of the port, by furnishing them with the means of having their vessels repaired under their own eye. It would also, most probably, bring other vessels to the harbour for repairs, and might be the means of bringing back the business of shipbuilding to the town, all of which would lead to the increase of the trade of the port.

A patent slip may generally be constructed cheaper than a graving dock, but there is not room in Kirkcaldy harbour for sufficient length of ways, and any situation on the open beach would afford too little water, and would leave the ways too much exposed; and, therefore, I think that a graving dock would, under the circumstances, be more suitable.

Both on the east and on the west sides of the harbour I have shown a space embanked off the sands for shipbuilding yards. Either would be quite suitable, though I would give the preference to the western side, as being the less exposed to the easterly sea; and the vessels may either be launched out

APPENDIX C.

KIRKCALDY.

No. 96.
Leslie, on the Improvement of the Harbour, and the Formation of Docks.

seawards or through the quay into the wet dock, or the tide harbour, by having the launching slips covered with portable wooden gangways.

The sea face of the two outer piers is proposed to be constructed with a pitched slope of 1½ horizontal to 1 perpendicular at the bottom, but curving upwards to nearly the perpendicular at the top, as shown in the sections; and this form I prefer to that of a nearly perpendicular face, as the force of the sea is, in a great measure, broken in rolling up the slope, and part of it is also caught by the projecting roundheads, so that the waves have less tendency to run along the back of the pier into the harbour.

I should have preferred to place the extension of the eastern pier in a position leaning more to the eastward, and pointing more out to sea, as it would have brought the pier-head into deeper water; it would also have given a better direction to the scour, and would have increased the size of the dock or of the harbour; but in order to reduce the expense as much as possible I have thought advisable to give it the same direction as the present east pier.

According to the proposed plan the wet dock would have 1,200 feet in length of wharf walls, which would afford quay berthage for about 1,600 tons of shipping, of the average size of 150 tons.

The inner harbour would have a quayage of 1,100 feet, and the outer harbour, without reckoning the east pier, which lies along the fairway, would have a length of quays of 550 feet.

Kirkcaldy harbour cannot, in my opinion, be made suitable for vessels of a very heavy draft of water; but, if the improvements herein spoken of were carried into effect, I think that the depth to which I propose to excavate the outer part of the harbour, viz., to about 2½ feet below the present fairway at the mouth of the harbour may, with occasional assistance from dredging or manual labour, be maintained by the greater strength of scour that could be afforded from the dock; and besides cleaning the channel up to the dock gates, this may be made to scour two of the quays of the outer tide harbour, by means of two tunnels with sluices through the quay, dividing that harbour from the dock.

This depth of excavation would give 16 feet of water in ordinary spring tides, and of 12 feet in ordinary neap tides; and I should think that this additional depth, together with the enlarged area and extended quay room, would most materially improve the harbour, and make it, merely as a mercantile harbour, quite fit to accommodate the trade of the town for many years to come.

On another point to which my attention was directed, viz., as to how far any improvements, which I would recommend, can be made subservient to afford better accommation for the ferry between Kirkcaldy and Mid-Lothian; I beg to state, that I do not see in what way the extension of the harbour, as required for purposes of general trade, can be made to any considerable extent to promote the object in view of facilitating the construction of a low-water pier.

If a dock were formed on the east sands, as I have heard proposed, it would shorten any low-water pier that might be constructed there; but I have an objection to any extension of the harbour to the eastward, at least to the size that would be required for a wet dock, unless the ground lying between the shore and the street were purchased to form part of it; as any such projection on the east sands, would throw the sea much more into the harbour-mouth, instead of allowing it to expend itself upon the beach; and it would not secure the advantage of having the harbour-mouth placed farther outward into deeper water, and of bringing the western part of the harbour more into the town, as proposed in the present plan.

If a low-water pier were to be carried out from the end of the east pier-head, it would be reduced in length about 200 feet, in consequence of the extension by the present plan; and the expense would, of course, also be diminished, but not very materially, and for reasons stated in my report on the most eligible site for a ferry pier, I object to any such erection as would be required for this site, as I think that it would interfere, injuriously, with the shipping trade of the harbour.

In order to give a proper direction to the water run from the dock, for the purpose of sluicing, and to cause it to keep a regular channel, instead of following a winding course over the sands, it might be found advisable to construct a low weir or hard, out from the east pier-head; and, as the scour would maintain a certain depth of water alongside of this weir, it may be formed so as to serve for a low-water pier or jetty, for small boats, and when the tide is high enough to cover it, the boats would have sufficient depth up to the harbour.

The weir would require to bend to the eastward, in the direction of the ebb tide, and must be well marked by beacons, to prevent vessels from grounding on it in scant water; and, as it would require to be but very little raised above the general level of the sands, it might not be at all objectionable on the score of danger to the shipping.

It would be serviceable in maintaining the proper fairway, and also would be a considerable convenience as a low-water landing for small boats; but beyond this, I am not prepared to show in what way the improvement of the harbour can be made subservient to affording better accommodation, for the purposes of a ferry.

The works herein proposed, although designed on the most economical scale, on which I could recommend any improvements to be undertaken, that are to go beyond mere repairs, or small alterations on the existing piers, would, nevertheless, very much exceed the sum which, according to my instructions, can be afforded for the immediate improvement of the harbour; and, therefore, if the plan were to be adopted, it would be necessary to commence with the execution of part of it only, taking care that what is done may be made, so far as it goes, to afford additional accommodation, and otherwise to improve the harbour, and at the same time to form a consistent part of the complete plan.

I would therefore propose to build, in the first place, the addition to the east pier and the whole of the west pier, which would inclose an area, in addition to the present harbour, of 4½ acres, and would give about 500 feet of berthage along the new west pier, with an access to the street opposite the coal-wynd.

This work might be executed for 18,600*l.* including so much excavation as would be necessary to form the hearting of the piers.

The piece of work next in order would be to build the quay connecting the new west pier with the old west pier at the entrance of the present basin, and to take down all the west pier inside of this point; so that then would be formed a half-tide basin of 3½ acres, as shown in plan No. 2. The walls of the present basin are, I believe, scarcely fit to retain water; but the walls of the enlarged basin would be all new, with the exception of the old middle pier on the east side, and I should think that this small portion may be made water-tight at no great expense.

The additional sum required for forming this enlarged basin, including its excavation to the depth of about a foot and a half below the bottom of the present basin, but merely sloping the side next to the

APPENDIX C.

KIRKCALDY.

No. 96.
Leslie, on the Improvement of the Harbour, and the Formation of Docks

street, instead of building quay walls there, and preserving the present entrance and gates, would be 3950*l.*

To build the north and east walls of the dock and its entrance lock, including a single pair of gates, and to excavate to the ultimate depth, and otherwise to complete the dock, and to form a fairway up to it, would take a further sum of 6825*l.*

To rebuild the outer arm of the present west pier, supposing it to be too narrow, or unfit for repair, to build the west and north quays of the inner harbour, and to excavate it and the outer harbour, and otherwise to complete the works described, except the graving dock, the building yards, and the weir, would take a further sum of 4640*l.*, or in all, from the commencement of the work, 34,025*l.*

The cost of the graving dock the building yards and the weir, I have not estimated, as they do not strictly form essential parts of the harbour.

The depths of excavation which I propose, and which are included in the estimate, are as follows:—

To make the bottom of the dock and the fairway to it, and all the outer harbour, 2 feet above low-water of good spring tides, which is assumed to be 24 feet below the point of the east pier. This level would be 5 feet 3 inches below the bottom of the present basin, and 2 feet 4 inches below the present fairway, opposite the west pier-head, and would give a depth of water in the harbour, of 16 feet in average spring tides, and of 12 feet in average neap tides.

From the fairway to the dock, which is taken at 75 feet in width along the inside of the old west pier, the bottom of the harbour will have an uniform slope upwards, to the north side at the street; and will there be of the same depth as it is just now in the north-east corner, where the Burn discharges itself into the harbour, viz., 6½ feet above low water, or 4½ feet above the level of the fairway to the dock, and this depth will be quite sufficient for small vessels, or for larger vessels to haul up to, when partially lightened.

On the plan and sections I have shown another improvement, which, although not strictly connected with the harbour, would, nevertheless, tend much to its advantage, by facilitating the access to it from the east, and would materially promote the interests of the town.

This scheme of improvement which has been frequently spoken of before, consists in straightening and extending the slope of the *path* so as to make it more safe and easy in ascent.

Between the toll and the division of the roads at the top of the path, a distance of 250 yards, the inclination is now 1 in 11½, and for 100 yards between the distillery and the sharp turn half way up, it is so steep as 1 in 10.

By cutting down the top 3 feet, and carrying out the road upon an embankment, and a bridge over the Den Burn, so as to run into the present level of the street where it opens up into the harbour, about half way between Smith's inn and the middle quay, the inclination may be reduced to 1 in 15.

This, although still rather steep for a public road, would nevertheless be a decided improvement upon the present state of the path; and from the road being made wide and straight, the risk of accidents from overturns or collisions would be very materially reduced; and I think that the plan is well worthy of the attention of the town council and of the road trustees.

The road is shown on the sections carried out on an earth-work embankment, with the exception of the arch over the Burn, and another close beside it, for a road through to the beach. There would be required about 30,000 cubic yards of stuff to form this embankment, and the cost of it would depend, mainly, on the facility with which the materials can be procured; but I consider that the whole expense of the work, exclusive of the purchase of property, would amount to nearly 3000*l.*

It might be found advisable to extend the arches farther west, as that would, in a great measure, save the purchase of property, and the arches would serve to keep open a communication between the street and the beach; and they might, in part, be also used for warehouses, or for workshops to the building yards, supposing these to be formed to the eastward of the harbour.

JAMES LESLIE.

No. 97.
Receipt and Expenditure for the Years 1842, 1843, and 1844.

No. 97.

Receipt and Expenditure for the Years 1842, 1843, *and* 1844.

Income.	1842.			1843.			1844.			Expenditure.	1842.			1843.			1844.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Anchorage on ships	377	7	8	324	5	1	361	8	5	Charge of collecting dues	127	1	1	122	9	10	128	17	8½
Shore dues on goods	1264	13	6	1111	1	5½	1136	5	10	Harbour lights	33	6	5	20	16	5	14	14	3
										Repair of piers, cranes, &c.	83	11	10½	55	19	4	60	16	1
										Salaries	22	10	0	25	7	0	24	2	1
										Wages of deepening harbour	56	0	3	50	9	1	30	10	4
										Interest of debt	..			24	11	2	182	13	3
	1642	1	2	1435	6	6½	1497	14	3		322	9	7½	299	12	10	441	13	8½

Amount of debt on the 31st December, 1845, 9963*l.*

BEVERIDGE RONALD, *Town Chamberlain.*

DYSART.

No. 98.
Return to Order of the House of Commons of the 9th August, 1844.

DYSART.

No. 98.

Return to Order of the House of Commons, of the 9th August, 1844.

1st. THE original Charters of the burgh have been lost.

2nd. The 26th Geo. II., intituled "An Act for laying a Duty of two pennies Scots, or one sixth part of a penny sterling on every Scots pint of Ale or Beer, which shall be brewed for Sale, brought into, tapped, or sold within the town of Dysart and Liberties thereof, and all Places adjacent lying within 300 yards

APPENDIX C.

DYSART.

No. 98.
Return to Order of the House of Commons of the 9th August, 1844.

of the boundaries of the said Liberties, for repairing, improving, and preserving the Harbour of the said Town," and the 43rd Geo. III., cap. 57, intituled "An Act for repairing, improving, and preserving the Harbour of Dysart, in the County of Fife," relate to the harbour of this port.

3rd. See copy plan and copy report, by James Leslie, Esq., civil engineer, Dundee, in 1838, sent as relative hereto.

It is proper to state that about 100 feet of the point of the east pier, as marked off on plan in red ink, was driven down by the violence of the sea the beginning of November last. Since then the navigation of the harbour has been somewhat impeded. The authorities are just now being furnished with plans for rebuilding the same, but they fear much difficulty may be experienced in accomplishing this from the low state of the burgh finances.

No. 99.

No. 99.
Leslie's Report on the Works necessary for the Security and Improvement of the Harbour.

Report by JAMES LESLIE, Esq., *on the Works necessary for the Security and Improvement of the Harbour.*

Dundee, May 25, 1838.

THE back wall of the outer kant of the eastern pier has suffered severely from the heavy easterly gales of last winter, and a great many of the stones have been loosened, and some of them torn quite out of their places, and it is quite necessary that some measure should be taken for its protection before next winter.

This outer kant is not so well built as the portion immediately further inwards, and is much too nearly perpendicular: and I think the only effectual way of making it secure would be to build a new wall outside of the old one, with a circular batter similar to the other part, with which it would be made to form a proper junction.

As I am informed, however, that the funds of the burgh are not adequate at the present time to such a heavy outlay as this operation would require, I would therefore in the meantime recommend that the old stones should be replaced as carefully as possible, and properly wedged in; and that the places which are bulged out and otherwise show symptoms of weakness, should be batted and cramped with iron, and that the remainder of the portion of the pier should be pinned, and otherwise repaired in the way that may seem most expedient as the whole proceeds.

The expense of this work it is impossible to estimate with anything like accuracy; but I should think by an outlay of from 50*l.* to 100*l.* the pier may be made to last for a good number of years.

To protect the dock gates, I would recommend to build a pier of 15 feet wide on the east side, so as to form an opening of 37 feet, being the same width as the gates between its outer end and the Ring Rock. From the narrowness of the opening, as compared with the size of the area within, the run against the gates would be very much checked; but if found necessary, a groove may be made for holding booms, which would form an effectual protection. These booms, however, must be much stronger than the old ones, and not less than 12 or 13 inches in thickness. Supposing, as I am informed, that the greater part of the stones for the work are already provided, or may be procured at a small cost from the quarry, I estimate the expense of the protection pier at 370*l.*

In order that the dock sill may be effectually repaired, it is necessary that the fairway should be deepened so as to allow the water to run quite off; and this is also required to give the full benefit of the depth of water on the gates to vessels entering or leaving the docks. I would therefore propose to deepen the fairway on an average of 1 foot, and to remove all the ridges which impede the water from running out, and are apt to injure vessels grounding upon them, and to give the channel an uniform declivity from the dock gates to the mouth of the harbour.

The estimate cost of this work is 76*l.*, and the probable repairs on the sills, &c. of the gates about 11*l.*

As the high rock on the north side of the dock, has now been quarried down further back than it was originally, there is now sufficient space for increasing the size of the dock, without reducing too much the width of the north quay, and by cutting down the rock carefully, and dressing off the face which will form the dock wall, a much better and smoother surface will be found than at present for vessels to bear against.

The cost of the work will be modified a good deal by the quantity and value of the rock that will be turned out; but it would probably be still too great to be attempted at the present time. It will be well, however, to keep it in view at any future period, when the funds may be adequate to effect this improvement. And when it is done, it will also be necessary, as the surface of the rock is soft and uneven to lay a proper coping on the top, behind which a metalled roadway may be formed.

JAMES LESLIE.

No. 100.

No. 100.
Return of Income and Expenditure for the Years 1842, 1843, and 1844.

Return of Income and Expenditure for the Years 1842, 1843, 1844.

Revenue.	£.	*s.*	*d.*
1841-42 . .	347	19	9
1842-43 . .	435	16	3½
1843-44 . .	339	16	0

Expenditure.	£.	*s.*	*d.*
1841-42 . .	210	3	10½
1842-43 . .	161	4	9
1843-44 . .	147	4	0

The revenue is levied according to use and wont, and under the authority of the managers of the Burgh.

Dysart, December 6, 1844.

THOMAS JUSTICE, *Treasurer.*

APPENDIX C.

METHILL.

No. 101.
Return to Address of the House of Commons, of the 29th July, 1844.

METHILL.

No. 101.

Return to Address of the House of Commons, of the 29th July, 1844.

SIR, *Wemyss Castle, July* 24, 1845.

AGREEABLY to your request, I send you a statement, shewing the receipts and expenditure of Methill harbour, in the years 1841, 1842, 1843; shewing an excess in outlay, in these three years, of 88*l*. 9*s*

It may be right to state that since 1st January, 1838, Captain Wemyss has laid out on Methill harbour (chiefly in restoring the eastern pier,—the west pier having previously been rebuilt) no less a sum than 4,990*l*. 8*s*. 3*d*. 1000*l*. of this, however, was contributed by Messrs. Neilson and Co., of Kirkland works; to be repaid them, as their shore dues shall admit of this.

Methill harbour, as you may be aware, has a greater depth of water than any below Burntisland, (18 feet to 20 feet in stream tides,) and has an area of four acres.

I am, &c.,
THOMAS BYWATER.

W. T. Moneypenny, Esq.

Income.	£	*s.*	*d.*	*Outlay.*	£	*s.*	*d.*
In 1841 . . .	67	1	1	In 1841 . . .	69	11	6
In 1842 . . .	34	19	3	In 1842 . . .	117	13	9
In 1843 . . .	21	12	5	In 1843 . . .	24	16	6
	£123	12	9		212	1	9
					123	12	9
				Against .	£88	9	0

Note.—Neilson and Co.'s shore dues in the above three years (retained by them) were 131*l*. 10*s*. 1*d*.

LEVEN.

No.102.
Return to Address of the House of Commons, of the 29th July, 1844.

LEVEN.

No. 102.

Return to Address of the House of Commons of the 29th July, 1845.

Income.	1842. £.	1842. *s.*	1842. *d.*	1843. £.	1843. *s.*	1843. *d.*	1844. £.	1844. *s.*	1844. *d.*	Expenditure.	1842. £.	1842. *s.*	1842. *d.*	1843. £.	1843. *s.*	1843. *d.*	1844. £.	1844. *s.*	1844. *d.*
Flax, yarn, and green cloth . .	47	7	10	61	7	9	67	3	5	Piling and clearing out mouth of harbour . . .	282	14	5		..			..	
Pig iron and castings	38	1	0	44	0	8	23	19	10	Collecting . .	29	9	2	25	0	0	25	0	0
Ships' anchorage and petty shore dues	44	12	6	45	15	8	28	8	5	Repairs . . .	12	9	7	31	9	1½	45	11	6
Wood	18	2	8	26	7	6	2	15	2										
Coals	25	12	10	16	18	3	23	6	4										
Potatoes . . .	2	7	2	2	17	11	0	9	3										
Grain	3	15	1	4	18	11	2	3	5										
Whiskey . . .	5	11	8	6	16	7	6	6	7										
Ochre	2	13	9	3	17	10	4	1	1										
£	188	6	6	213	1	1	158	13	6	£	324	13	2	56	9	1½	70	11	6

N.B.—The harbour dues are levied under the authority of the proprietor of the harbour.

Durie, December 17, 1844. C. M. CHRISTIE, *Proprietor of the Harbour.*

ELIE.

No. 103.
Messrs. Stevenson and Son, on forming a Harbour of Refuge

ELIE.

No. 103.

MESSRS. STEVENSON and SON, *on forming a Harbour of Refuge at Elie; and Estimate*, 1836.

Edinburgh, 23*rd Sept*., 1836.

IN the year 1815, our senior Reporter had the improvement of the harbour of Elie, in Fifeshire, brought under his consideration by the late Colonel Anstruther, when he reported his opinion as to the best mode of obtaining a more extended accommodation for shipping. The Reporters have again been applied to through Mr. Pagan, writer in Cupar, with instructions to reconsider the subject. Having accordingly visited Elie, and had the views of the parties taking interest in this improvement explained on the spot, they have since made a minute survey with soundings, and also made a plan and sections of a piece of road in connection with the proposed measure. In all their inquiries regarding this business, they have received much assistance from Captain Randal, R.N., whose experience has enabled him to furnish much useful information, and they now beg to report their opinion as follows:—

The importance and necessity of a refuge harbour on the eastern coast of Great Britain might entitle the improvement of Elie harbour on an extended scale to serious consideration, as has been stated in the former report alluded to. The extent of anchorage, and the ease of entering Elie, together with the fitness of the bay for inclosure, by means of deep-water piers, readily point it out as a situation well calculated to supply the deficiency of shelter for vessels in gales on the east coast and

APPENDIX C.

ELIE.

No. 103.
Stevenson, on forming a Harbour of Refuge.

North Sea; and more immediately for the coasting trade of the Firth of Forth when overtaken by westerly winds, which prevents their getting up to Leith Roads, or when easterly winds prevail, so that they cannot get out to sea. Elie has long been regarded as a rendezvous for shipping, as is proved by many existing documents well known to the promoters of this measure. But the amount of funds at the disposal of the parties who take an interest in Elie harbour is so small as to exclude any extended view of the question, and the Reporters have therefore in this plan confined their inquiries to the means of improving it on a smaller scale of operation, by confining the works to what may be considered more within the compass of the funds at their disposal.

It is now many years since a breach was made in the pier-head, at Elie, which has since been entirely thrown down to the extent of 70 feet. The berthage of vessels has consequently been greatly impaired, and the harbour laid so open as to have been considerably banked up with sand. The roadway of the present pier is only 12 feet in breadth; but if the funds had been sufficient the Reporters would have proposed to have added four feet to its breadth, so as to admit the free traffic of carts to the vessels' sides. But the most essential work connected with the pier is to rebuild the outer part, which now lies in ruins as shown in the enlarged plan. It is, however, proposed to make the roadway of the rebuilt part of the breadth of 20 feet agreeably to the section on the line A B. The head of the pier will thus be considerably strengthened; and at any future period the old or landward part can be widened, and thus a continuous roadway of sufficient width will be obtained to the interior of the harbour. The expense of rebuilding the pier agreeably to the annexed estimate amounts to 1404*l*. 12*s*. 4*d*., including 10 per cent. for incidents.

It appears to be the opinion of the promoters of this measure that the present advanced state of steam navigation, and the general demand for the agricultural produce and live stock of the country, for the supply of the London market, would render the establishment of a deep-water shipping place at Elie an eligible improvement; and the Reporters have accordingly had their attention specially directed to the best means of obtaining temporary berthage for steamers, calling on their passage through the Firth. As these vessels are not fitted for taking the ground, and their voyages are so precisely confined to time, they cannot wait tide for access in the usual way; and it therefore becomes necessary to provide a quay which they can approach during a considerable part of each tide. To obtain the necessary depth in a sheltered harbour at Elie would be a work of magnitude, and necessarily of great expense; and the Reporters have consequently directed their inquiries to such measures as may be calculated in some degree to meet the funds about to be raised for this measure. They have therefore to propose the erection of a temporary wharfage for steam-vessels, at two points marked on the plan; the north-eastern one is called the Apple Rock, and the south-eastern one the Lucky-Hole; to either of which access may be had according to the direction of the wind and state of the weather, with a depth of from 4 to 5 feet at low water spring tides.

By the plan, it will be seen that these wharfs lie on opposite sides of the rocks, which form the Flagstaff Hill, bounding the exterior of the present harbour. In forming these wharfs, it is proposed to dress down the rocks to a certain extent, and to raise upon them breastwalls of masonry, protected with defenders of timber, to prevent injury to vessels which come alongside. They had also designed a timber wharf to surmount the rock, instead of the walls of masonry, and a view of both methods has been laid down in the diagrams on the plan. But to execute a substantial timber wharf in this exposed situation they found would come to nearly as much expense as the wharf of masonry to which they had given preference. Agreeably to the annexed estimate, the expense of the masonry amounts to 879*l*. 3*s*. 6*d*. for the Apple Rock, and 1055*l*. 0*s*. 2*d*. for the Lucky-Hole. From the unworkable nature of the rock, and as all the materials, of suitable dimensions and good quality, must be brought from a distance by sea, it is difficult to come at the precise expense in cases of this kind; but these estimates have been calculated in such a manner as fully to meet the expense.

The landing at these wharfs must be made convenient and useful, in communicating with the town of Elie, and the main roads of the country. It is also wished to make provision for a cattle pen upon the top of the rock, in connection with these wharfs, by building a wall contiguous to the Apple Rock, in the direction of the dotted lines, so as to inclose a piece of waste ground, which may be accomplished at a comparatively small expense.

The landward access to the harbour of Elie is extremely incommodious, and in certain states of the tide and weather, it is pretty nearly inaccessible along the shore, between the harbour and Wade's Bay. To remedy this evil, it is proposed to form an improved line of road, to the extent of about one quarter of a mile from the Swash dyke northward, to join the turnpike road near the gate of Elie House. This piece of road, bower, is not included in the present estimate, as it is considered better to proceed with those parts of the work which are more immediately connected with the shipping; and, therefore, the road operations are for the present confined to the dressing of the rocks, and making up the roadway and wharfs as delineated in red colour on the plan and sections; and to the restoring of the Swash dyke. This latter work is considered indispensably necessary, not only for keeping up the communication with the harbour at all times of tide, but also to check the washing of the sand of Wade's Bay into the harbour. Upon the site of this dyke, the Reporters propose to form a roadway 20 feet in breadth, with a rough talus or sloping wall, where necessary, as shown in the section on the line C D on the plan. This work, including its connection with the wharfs at the Lucky-Hole and Apple Rock, is estimated at 1635*l*. 5*s*. 9*d*.

This may be considered a large sum, but will nevertheless be required to render the access to the harbour convenient. It, however, would appear, from the public nature of Elie harbour, and its connection with one of the most valuable districts of Fife, that the road trust will come forward in aid of the funds, which may be necessary for rendering this central harbour accessible as a place of public and general resort.

Sir Ralph Anstruther, and the other Promoters of the Improvement of Elie Harbour.

ROBERT STEVENSON & SON.

No. 103.
Stevenson, on forming a Harbour of Refuge.

Estimate of the Expense of Improving the Harbour of Elie, agreeably to the accompanying Plan and foregoing Report.

Rebuilding Old Pier Head.

	£.	s.	d.
935 cubic yards in outward walls and parapet, at 22*s*. 6*d*.	1051	17	6
770 cubic yards of hearting between the outward walls, at 3*s*. 6*d*.	134	15	0
108 superficial yards of pitching on the roadway of the pier, at 7*s*. 6*d*.	40	10	0
180 cubic feet of timber work in defenders, with iron work and fixing, at 5*s*.	45	0	0
96 cubic feet in boat stairs, at 1*s*.	4	16	0
	1276	18	6
Incidents, at 10 per cent.	127	13	10
	£1404	12	4

Masonry in Pier at Apple Rock.

	£.	s.	d.
155 cubic yards in outward walls for end or breast of quay, at 35*s*.	£ 271	5	0
267 cubic yards of ditto, ford sides, at 25*s*.	333	15	0
600 yards of hearting, at 3*s*.	90	0	0
Dressing foundations in rock	42	0	0
166 superficial yards of pitching	62	5	0
	799	5	0
Contingencies, at 10s. per cent.	79	18	6
	£879	3	6

The Lucky-Hole.

	£.	s.	d.
To the expense of forming and completing the deep water wharf at the Lucky-Hole, calculated upon similar data as the above	£1055	0	2

Roadway across the Swash-way, and till it joins the Two Deep-Water Wharfs.

	£.	s.	d.
6,213 cubic yards of filling in the road of 450 yards in length, and of the average depth of 5 feet, and 20 feet in width at top, with talus walls sloping outward, at an angle of 45 degrees, at 2*s*. 6*d*.	£776	12	6
1,560 superficial yards of talus walls, in the line of the swash dyke, at 7*s*. 6*d*.	585	0	0
500 lineal yards of forming, dressing, and roadmaking, at 5*s*.	125	0	0
	1486	12	6
Incidents	148	13	3
	£1635	5	9

Summary Estimate.

	£.	s.	d.
For rebuilding pier	£1404	12	4
For deep-water pier at Apple Rock	879	3	6
Ditto ditto at the Lucky-Hole	1055	0	2
For road across the swash-way continued to the deep-water piers	1635	5	9
	£4974	1	9

No. 104.
The Master Mariners of St. Monance, on the value of Elie as a Harbour of Shelter, &c.

No. 104.

The Master Mariners of St. Monance on the value of Elie as a Harbour of Shelter, &c.

St. Monance, February 27, 1838.

FOR these several weeks past our town has exhibited all the stir and bustle imaginable from the excitement of bad weather; never did the fishermen of St. Monance experience more trying scenes. Great praise is due to Captain Randall and crew of the Coast Guard at Elie for his unwearied and indefatigable perseverance in preserving the boats that came to that port. On Saturday, the 17th February, the Coast Guard assisted five large boats into Elie harbour; and, from the heavy sea on, the first boat with the crew would have perished, but for them. On Saturday, the 24th, David Marr (on his passage from Leith to this port) was obliged to put into Elie with his boat by stress of weather, and was kindly assisted and preserved by the activity of this useful establishment. These two cases are sufficient to establish the importance of Elie harbour, for were it not for this place, and particularly the assistance always at hand, the fishers of St. Monance, Pittenweem, and Cellardykes would not be able to follow their hardy and too often dangerous vocation to the extent they now do; but if these two cases are not sufficient for this purpose, we would ask the survivors of that awfully destructive gale, from the S.E., on the 20th February, 1833, what would have become of them had not the Coast Guard boat lain outside to wave in seven boats, seen coming up from the May and running for Cocklemill Burn, when five saw the signals and hauled up for the harbour, and got in safe while, the two sternmost, not seeing the signals till too far to leeward, kept their course, and one foundered with all hands on board off the Vows! There were on this ever-to-be-remembered day in all seven boats, with forty-two men, saved by taking Elie harbour, ruinous as the pier and sea wall are. It is well

APPENDIX.

ELIE.

No. 104.
The Master Mariners of St. Monance, on the value of Elie as a Harbour of Shelter, &c.

known that Elie has been considered, and justly, a refuge harbour for these two or three hundred years, and to be the only place in the Firth where during easterly gales boats and vessels can go in or out at pleasure, whilst all other harbours would prove destructive to those attempting them under like circumstances. As to vessels we dont say much, but we have heard from time to time that all who run for Elie in westerly gales experience the same assistance as our boats, and that many a vessel and crew have been saved by the Coast Guard. We only regret the deplorable condition of that ruinous haven, and we hope before long that some person or persons will come forward and repair that useful place of such importance to seamen. We, the undersigned, wish to express our gratitude to that gentleman and his crew for their kind assistance; and we trust that our brethren in the neighbourhood will come forward with us and express their thanks for their unwearied exertions. Never did men, we believe, in that service exert themselves better.

DAVID MARR, and 10 others.

PITTENWEEM.

No. 105.

Return to Order of the House of Commons of the 9th August, 1844.

PITTENWEEM.

No. 105.
Return to Order of the House of Commons of the 9th August, 1844.

Pittenweem, February 5, 1845.

1. ROYAL Charter granted by King James V. of Scotland, in favour of John Rowell, Prior of Pittenweem, and convent thereof, dated at St. Andrews, the 24th day of February, 1542, and of his reign the 28th year, by which Charter His Majesty erected, made, and created "Villam et terras de Pittenweem cum pertinentibus in liberum burgum regalem pro perpetuo, &c., cum anchoragiis seu omnibus aliis commoditatibus aut libertatibus portus et pleni maris, et secuti burgam de Edinburgh seu alios burgos infra regnum in burgum regalem efficitur."

2. Charter granted by the said John Rowell, with the consent of the foresaid most noble Prince and others, of date the 12th day of February, 1547, in favor of the provost, bailies, council, community, burgesses, and inhabitants of the said burgh. "Cumque anchoragiis ac omnibus commoditatibus proficiis et libertatibus nostri portus et pleni maris de Pittenweem et salt panis pro manutentione reparatione et conservatione de lie (bulwark) in dicto nostro porto construit et aliter in dicti nostri burgi et ejusdem reipublicæ usus in perpetuam disponendis et applicandis."

3. Instrument of Sasine following thereon, dated the 11th day of October, 1549.

4. Act of King Charles I. and the estates of the Parliament of Scotland, passed at Edinburgh on the 28th day of June, 1633, ratifying, approving of, and confirming the foresaid Charters and infeftment.

The Reporter begs to state that there are no maps of the harbour or port in possession of him or his colleagues in office; that there are not any reports by engineers or other officers respecting the port or harbour; and that there have been no complaints made to the magistrates as to defects in the said harbour.

Humbly reported by
WM. WILKIE, *C. M.*

No. 106.

Return of Income and Expenditure for the Years 1842, 1843, *and* 1844.

No. 106.
Return of Income and Expenditure for the Years 1842, 1843, and 1844.

Income.	1842.	1843.	1844.	Expenditure.	1842.	1843.	1844.
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Total income by lease . . .	99 5 0	80 5 0	55 10 0	Salaries, fees, &c.	6 10 0	10 14 0	7 4 0
				Repairs of harbour, &c. . .	145 3 2	65 14 10	21 19 7
					151 13 2	76 8 10	29 3 7

N.B.—Dues are levied under an Act of the Parliament of Scotland, 1633, confirming the Royal Charters in favour of the burgh, which conferred the rights to exact customs, anchorage, &c., and subsequent minutes of the town council modifying the tables of rates as the altered circumstances of the time required.

Pittenweem, November 29, 1844.
W. WILKIE, *C. M.*

ANSTRUTHER.

No. 107.

Return to Order of the House of Commons of the 9th August, 1844.

ANSTRUTHER.

No. 107.
Return to Order of the House of Commons of the 9th August, 1844.

Anstruther, February 12, 1845.

1. THE town acquired right to the harbour of Anstruther, with all and sundry the customs, anchorages, profits, privileges, casualties, and commodities of the same, conform to two Charters granted in the years 1564 and 1580, by Sir John Anstruther, of that ilk, followed by infeftments, and subsequently confirmed by Royal Charter, erecting the town with the haven into a free burgh royal. These title deeds are not in possession of the town, but appear to have been produced in a process, in which the town was a party, before the Court of Session, about the year 1762.

2. The town is not in possession of any Acts of Parliament, or Charters and Commissions relative to the harbour, but the magistrates and council act on a table of customs, anchorages, and shore dues, made out by the town council, of date the 11th September, 1731.

3. There are no maps or reports by engineers as to the harbour presently in the town's possession; but a plan of the harbour was made out a number of years since by Mr. Stevenson, civil engineer,

APPENDIX C.

ANSTRUTHER.

No. 107.
Return to Order of the House of Commons, of the 9th August, 1844.

which was sometime ago given to Mr. Mitchell, the engineer to the Board of Fisheries, to assist him in making a survey in connection with a proposed low-water harbour, at Craignoon, in the immediate neighbourhood. This plan has not yet been returned.

4. Neither is the town in possession of any complaints relative to defects of said harbour.

Reported by
GEORGE DARCIE, *C. M.*

Note.—The magistrates are in course of making inquiries after certain documents bearing upon the above matters, and if successful in the search, a supplementary return will be forwarded.

G. D.

No. 108.
Return to Address of the House of Commons of the 29th July, 1844.

No. 108.

Return to Address of the House of Commons of the 29th *July*, 1844.

Income.	1841.			1842.			1843.			Expenditure.	1841.			1842.			1843.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Anchorage and Shore Dues . .	161	0	0	161	0	0	172	0	0	Repairs of piers and wharfs . .	11	10	0	20	10	0	11	0	0
										Quarrying out rocks in fairway . .	6	0	0		..			..	
											17	10	0	20	10	0	11	0	0

The dues are levied under authority of the Magistrates and Town Council.

Anstruther, December 11, 1844. GEORGE DARCIE, *C.M.*

CRAIL.

No. 109.
Return to Order of the House of Commons of the 9th August, 1844.

CRAIL.

No. 109.

Return to Order of the House of Commons of the 9th August, 1844.

THE magistrates and town council of this burgh act under the authority of the Charters granted by Robert I., and Robert II.; ratified by Mary in the year 1535, and confirmed by a Charter granted by Charles I. in 1635.

The council have not in their possession any plan of the harbour, neither have any complaints been made of its defects.

ALEXANDER SIM, *Treasurer.*

No. 110.
Leslie, on forming an Asylum Harbour at Rome, on the eastern part of the Town of Crail.

No. 110.

MR. LESLIE, C.E., *on forming an Asylum Harbour at Rome, on the Eastern part of the Town of Crail.*

Dundee, April 30, 1846.

AGREEABLY to instructions given me by the magistrates, I, last July, examined the harbour of Crail and the adjacent coast, and more particularly the cove or natural harbour of Rome, lying immediately to the east of the town, which had been pointed out as forming a very eligible site for a low-water or asylum harbour. I have since then had an accurate survey made of the coast from Kilminning, about one mile east, to another point about one mile west of Rome harbour, and have had soundings taken, and the sets of the tide carefully observed. These are all laid down on the accompanying plan, on which I have drawn, in red lines, a design for an asylum harbour, made out after having consulted and heard the suggestions of nautical men and others well acquainted with the coast.

The proposed site has very considerable nautical advantages, from its being much sheltered by the high land and rocks, both on the east and west, and having clear ground and good anchorage immediately off the entrance, and for a considerable extent in either direction outside.

It is a part of the Firth where the shelter of a harbour is very much wanted, to save vessels from having to run up, in easterly gales, to the lee of Inchkeith, or to Burntisland Roads, or even above Queensferry; and where it would be of great use also in westerly gales, which, although they do not raise such a heavy swell in the Firth of Forth as those off the German Ocean do, are nevertheless more frequent and often more violent; so that it is no uncommon thing for vessels to be blown out of the Firth by a heavy south-wester, for want of some secure place of refuge which they might run to.

There are two plans laid down, of which the larger has a depth at its mouth of 18 feet at low water of spring tides. It encloses an area of 16 acres, covered at low water, and having a depth, at that state of the tide, varying from 5 to 18 feet, and 23 acres between low water and high water,—thus giving a total area at high water of 39 acres.

The space below low water has a clear bottom, all except one sunken rock, which might be blown up or buoyed. The shore above low water is very rough and uneven, consisting of rocks and large stones, which would serve for the hearting or foundation of the piers, and their removal would increase materially the available area of the harbour. Some of the ridges of rocks might be left, with advantage, to form a shelter for an inner harbour; and there would be ample room and great facilities for constructing a wet dock, or a repairing dock, or slip, between high and low water.

Lest this plan should be thought to be on too extensive a scale, there is also a plan of a smaller harbour, shown by red dotted lines, with its mouth placed where there is a depth of 16 feet at low water of spring tides. It encloses an area of 8 acres below low water, and varying in depth from 5 to 16 feet, and of 15½ acres between high water and low water,—thus making the total area, inclosed within the piers, 23½ acres.

APPENDIX C.

CRAIL.

No. 110.
Leslie, on forming an Asylum Harbour at Rome, on the eastern part of the Town of Crail.

The advantages of the smaller plan, are, on the whole, nearly the same as those of the larger one, excepting that the deep water space is much reduced. The mouth would be rather more sheltered by being more embayed; but, for the same reason, there would be less facility for vessels leaving the harbour with a wind right in; as in that case it would be more difficult to lie such a course as would clear the projecting points of rocks situated on the east and west of the harbour.

The mouth of the larger harbour is open (by magnetic) from E.S.E. to S.W. by W., or 11 points at low water; and for some hours before and after high water, there is a point or more to spare on either side, with sufficient depth over the rocks, so that it would be possible for a sailing vessel to shape a course from the harbour mouth out to sea, in any direction of the wind.

As the beach, for a great distance on either side, is bare rock, without any sand or shingle over it, and as there is no considerable stream near, to bring down sand or mud from the land, there seems no reason to apprehend any danger of deposits taking place in the harbour, so as to reduce its available depth in any material degree.

The harbour mouth is made 200 feet wide. Of course a smaller width would give more perfect shelter inside, but it would increase the difficulty of taking the entrance, and it would promote the tendency, if there were any, to silt up. The harbour, according to the larger design, would be fit to afford shelter and floating accommodation at low water to above 100 vessels, averaging 100 tons burthen each, if the piers were built upright inside, so as to allow vessels being berthed alongside of them; and according to the smaller design, it would accommodate nearly half that number of a similar tonnage; and as there would be no objections to the smaller class of vessels taking the ground, a great many small craft might be accommodated, in addition to the number mentioned, upon the beach, above low water.

If a sloping breakwater, or any similar form, were adopted for the inner face, there might be considerable economy in the construction, but it would make the harbour much less commodious, and practically less capacious.

Supposing the two heads, and the inner face of the piers, to be built under low water by caissone or bell work, and the back slope founded on rubble stones, thrown down promiscuously under water, and brought up from that level, of good pitching, with a high and substantial protecting parapet, the larger plan would cost, according to my estimate, 142,500*l.*, and the smaller plan 107,600*l.*

Supposing the inner face also to be founded on stones, tumbled into the water, and formed above low water with a pitched slope, and the outer face to have no parapet, the cost of the larger plan would be 108,850*l.*, and of the smaller plan 81,900*l.*

If the breakwater plan were adopted, a wooden gangway might be carried along for access to the outer head, when the sea is breaking over the masonry.

No information has been given for my guidance as to what extent of accommodation would be required or is expected, or as to what expense I might venture to propose to be laid out on the works; but, as it appears to me, that either of the plans, or any other that could be proposed to serve the purpose in view, would be too expensive, unless taken up by the Government as a national harbour of refuge, or some other public fund be provided for its erection and maintenance, it would, in my opinion, be most desirable that the larger plan should be adopted. Still, however, the smaller one would afford very good shelter and considerable accommodation, and would be a very great advantage to almost every class of vessels frequenting the Firth of Forth, or passing the mouth of it, and might be the means of saving much loss of time in working up or down the Firth, and of preventing many a disastrous shipwreck.

JAMES LESLIE.

No. 111.

No. 111.
Return of Income and Expenditure for the Years 1842, 1843, and 1844.

Return of Income and Expenditure for the Years 1842, 1843, and 1844.

Income.	1842.			1843.			1844.			Expenditure.	1842.			1843.			1844.		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*		£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
Shore dues and anchorage . .	44	3	0	60	0	0	67	15	0	Repairs and improvements . .	94	16	3	19	19	1	51	0	10
Tiends	8	3	0	7	12	0	4	5	0										
	50	6	0	67	12	0	72	0	0										

N.B.—The dues are levied under the authority of the magistrates and town council of Crail.

ALEXANDER SIM, *Treasurer.*

ST. ANDREWS.

ST. ANDREWS.

No. 112.

No. 112.
Return to Order of the House of Commons of the 9th of August, 1844.

Return to Order of the House of Commons of the 9th August, 1844.

1. THE magistrates and town council of St. Andrews, were by Charter dated 18th August, 1614, granted in favour of the city, by George, then Archbishop of St. Andrews, empowered to levy all anchorages, customs, commodities, and dues of the harbour, excepting in favour of the Archbishop and his successors, the large customs belonging to them, and the liberty of Admiralty of the harbour.

This Charter was confirmed by a Charter of King James VI., dated the 28th February, 1620.

The whole customs and dues of the harbour are now levied by the magistrates, on behalf of the city.

2. A copy of a map of the harbour is herewith sent.

3. There are herewith sent excerpts from the minutes of meeting of the town council of St. Andrews, relative to complaints made to the magistrates as to the defects of the harbour; together with copy of a memorial and petition presented in 1816 by the magistrates to the Commissioners appointed by Parliament for the improvement of Highland roads and bridges. Nothing appears to

APPENDIX C.

ST. ANDREWS.

No. 112.

have been done on this memorial and petition, with the exception of what may be gathered from the excerpt of the council minutes of 17th July, 1816 (No 114). The engineer's report alluded to in the memorial cannot be found. It may possibly be in the possession of the above Parliamentary Commission.

H. L. P. **PLAYFAIR**, *Provost, St. Andrews.*

No. 113. Memorial of the Provost, Magistrates, and Town Council, to the Commissioners of Highland Roads and Bridges.

No. 113.

Memorial of the Provost, Magistrates, and Town Council, to the Commissioners of Highland Roads and Bridges.

The Memorial and Petition of the Lord Provost, Magistrates, and Town Council, of the Royal Burgh and Metropolitan City of St. Andrews,

MOST HUMBLY STATES,

THAT the harbour of St. Andrews, from a want of repair, has fallen into great decay.

That this has arisen partly from the decay of the trade in the city, and partly from the dangerous and ruinous state in which the harbour has for some time been, deterring mariners from frequenting the port, and from the funds of the city being totally inadequate to make any substantial repair thereon.

The harbour of St. Andrew's is of much general, as well as local advantage; situated at the bottom of a deep bay, it is rendered dangerous, by being often mistaken by mariners for the Firth of Forth; a ship once embayed in a storm from the east, betwixt the Firth of Forth and Tay, can take no other harbour but St. Andrew's, and from its ruinous state, vessels have been stranded and lost off the harbour.

The state of the harbour has long been a matter of complaint by mariners frequenting this stormy and dangerous coast, and the magistrates have been long employed devising means to remedy the evil complained of. The means considered most likely to attain so desirable an end, was an extension of the piers, of which the magistrates procured a plan and an estimate of the expense, and which plan accompanies this memorial. The estimated expense amounts to betwixt 3000*l*. and 3200*l*. and the city being totally unable to raise more than 600*l*., the magistrates laid the plan and estimate before the Commissioners of the Royal Burghs of Scotland, assembled at their annual convention; and the burghs having deliberated thereon, and having read and considered the report of Mr. Stevenson, engineer to the royal burgh, they approved of the plan, considering it of much benefit to the mercantile interest, as well as of great advantage to the city of St. Andrew's; and they voted 600*l*. of their funds for carrying into effect the improvement.

In the ensuing convention, the royal burgh again considered the situation of the harbour of St. Andrew's, and unanimously recommended it to the consideration of Parliament as a matter of public interest and utility, and they directed their agent to communicate their opinion to all the members of Parliament connected with the royal burghs of Scotland, and to request them to give their assistance in procuring a grant of money to carry through the work.

The magistrates beg leave to remind the commissioners of the ancient grandeur of the city, of its being the oldest University in Scotland, and its early and long continued connection with the principal events in Scottish history.

They beg leave to state that the harbour has been always considered as a matter of national importance from the earliest period; and that in the year 1728 a brief was obtained (of which a copy is annexed) for a collection in all the churches and chapels of Great Britain, and a sum of betwixt 2000*l*. and 3000*l*. was collected, which was expended on the harbour by the Commissioners appointed by the Patent.

The magistrates beg leave to assure the commissioners that the improvement of the harbour of St. Andrew's will lessen the danger of navigation on a dangerous and stormy coast exposed to violent storms from the east, and save many lives and much merchandize.

The magistrates are ready, if necessary, to prove all the statements in this memorial, and to enter into such engagements and under such directions as to the Commissioners may seem proper, and faithfully to apply the money to the repair of the harbour; they therefore pray your Honourable Commission would grant to them the sum of 2000*l*., or such sum as you may judge expedient for this necessary and useful purpose.

And your petitioners shall ever pray.

(Signed) ROB. MELDRUM, *Provost.*
ROB. KEY, *Dean of Guild.*
JAMES TODIE, *Bailie.*
B. ALEX. MELDRUM, *Bailie.*

Read, approved of, signed, and sealed by the common seal of the city of St. Andrew's, and by authority of the magistrates and town council at St. Andrew's, this 30th day of March, 1816, by me,

(Signed) CHARLES GRACE, *Town Clerk.*

No. 114. Notes and Extracts from Proceedings of the Town Council relative to the Harbour.

No 114.

Notes and Extracts from Minutes of Proceedings of the Town Council of St. Andrews, relative to the Harbour, communicated by Major PLAYFAIR, *Provost of the Burgh.*

THE pier at the harbour was originally constructed of double piles of wood fastened in the rock, and large rough stones were filled in between these piles. On reference to the old plan of the city, prefixed to Mr. Lyon's History, there appears to have been another pier, about 100 yards to the south of the present pier, and parallel thereto. At what period these piers were built I have not been able to ascertain, probably about the year 1100, in the reign of Alexander I.

A. D. 1559.—The stone pier was substituted for the wooden one after the Reformation, but not of the length it stands at present: many of the stones of which it is built were taken from the ruins of the Cathedral.

APPENDIX C.

ST. ANDREWS.

No. 114.
Notes and Extracts from Proceedings of the Town Council relative to the Harbour.

In 1656 the pier was destroyed by a great storm, and a collection was made in the churches for its reparation.

In 1662 King Charles II. gave 162*l.* towards the Bow Bridge and Pier.

In 1700 the Convention of Burghs applied to in regard to the harbour, and to inspect the same.

In 1712 the Cross Pier found to have been much injured by a late storm.

November 8, the Cross Pier rebuilt and repaired: the Convention of Burghs gave 62*l.* or 1200 merks towards this.

Sept. 1, 1725. The Convention of Burghs met at St. Andrews to inspect the harbour: they reported the south end of the Cross Pier again damaged: they inspected the town revenue and books, and expenses, and recommended the Convention to be appealed to; and a general subscription to be raised through England and Scotland. This proposal appears to have been attended with success, as no less a sum than 2700*l.* was raised on this account.

May 14, 1761. The Council resolve to lengthen the Long Pier as far as the Beacon Rock, with the balance of the money collected through England and Scotland by H. M. Brieve.

Dec. 18. The Council appoint a committee, to call on the trustees appointed by Government for their accounts; and how the 2700*l.* collected has been expended.

1762. No answer having been received, resolved to address the surviving trustees to account for their intromissions.

1765. Still no answer. Letters to be written to the surviving trustees, and the heirs of such as are deceased, for their accounts as to the harbour.

1766. No answer being received, the Council empower two magistrates and their clerk to go to Mr. Bethune Clatto, and to Mr. James Anderson, advocate, who have the keys of the strong box of the trustees, and to demand the accounts of the trustees for inspection.

1783. The above threat appears to have succeeded: a resolution is made to lengthen the pier, the trustees paying towards it 1000 guineas.

March 26, 1783. An extract from the minutes of the harbour trustees was read at Council, in which, at a meeting 25th March, they resolved to expend 1000 guineas on extending the pier eastwards to the beacon; to deepen the harbour 2½ feet, and to remove the rocks called the Burn Stools.

July 24. An offer made by Walter Bain, mason, Dundee, and accepted; and the Council allocate the sum of 14*l.* per annum for fifteen years to the harbour trustees, or until the sum in their hands shall amount to 500*l.*, payable from the street dung.

Dec. 20, 1784. Walter Bain reports the pier finished, and requests the work to be inspected and taken off his hands, and to fix the time when his upholding it for three years is to commence.

The report of men of skill as to the sufficiency of the work is received and approved of: the term for upholding is fixed at December 20, 1787; the Council appointed Walter Bain hereditary burgess of the city, free of all expense, in testimony of the high value they set on his services.

Resolve, to grant a site for a bathing-house to the trustees of the harbour; any revenue arising therefrom to go to the harbour funds: and subscribe 10 guineas.

The harbour is much filled up with sand since the new pier was built; men of skill are ordered to inspect the bank, and report how this evil can be cured or removed.

June 17, 1785. The harbour mouth being much filled up with sand, estimates to remove it and construct flood-gates were advertised for, but no offers were sent in. Walter Bain agreed to deepen the harbour 2½ feet for 100*l.*, and wishes to be relieved from his contract, and agrees to construct instead a new pier opposite the Fern Head, and to take down the west pier and rebuild it, leaving 28 feet clear, and to place flood-gates in this space to contain the water, so that when the tide is out and the gates opened, the rush of water will clear away the sand in the mouth of the harbour. He, the said Walter Bain, is bound also to lift all the loose stones at the Burn Stools, which he must carry off, and lay them down at the head of the south pier, stretching to the commencement of the Burn Stools: which is accepted.

Nov. 17, 1786. Walter Bain reports the sluice piers all finished except the gates, which are to be built by John Edie of this place, and wishes 100*l.*: granted.

Oct. 31, 1787. Walter Bain applies to be relieved from his contract of the sluice-gates, as they are now all finished.

The Council defer doing so, as the water runs out, the old and new work not being properly secured: they also direct him to level the Burn Stools as per agreement, and refer him to men of skill for their report.

Feb. 13, 1788. A report from the harbour trustees laid before the Council, complaining of indications of the fall of the pier of a formidable appearance.

March 7. Report of the downfall of the pier, February 22nd last.

Also read to the Council a report from the annual committee of the Council, of February 27, that one-half of the new pier lately built by Walter Bain had fallen down on February 22, and that the passage either into or out of the harbour was entirely obstructed even for the smallest vessel: that Walter Bain was sent for the same day; but has taken no steps to clear the harbour or rebuild the pier.

Legal proceedings commenced against Walter Bain.

April 1. The harbour trustees decline prosecuting, but direct the Town Council to do so; the trustees agree to advance the law expenses, provided the Town Council extend the period of payment of the 14*l.* annually, so long as it may be required to indemnify them: which is agreed to.

Dec. 2. Captain Duncan advanced certain sums for the repairs of the harbour, which were going on. A letter from Mr. Bain's agent received, offering a compromise in money to get clear of the whole work: in consequence of this law proceedings were delayed for a time.

April 3, 1789. A minute of a conjunct meeting of the Town Council and Harbour Trustees, requesting money to pay Captain Duncan for his advances in rebuilding the pier, and for completing the parapet walls and bulwarks during the summer; the Council to free the trustees

APPENDIX C.

ST. ANDREWS.

No. 114.
Notes and Extracts from Proceedings of the Town Council relative to the Harbour.

of the expenses of the law plea, and to get payment from the trustees of such money as they are possessed of.

April 25. The Council order that 200*l.* be borrowed to finish the pier according to Mr. Steven's plan, as well as the parapet and buttresses; and appoint a committee to compromise with Mr. Bain on equitable terms.

March 25, 1790. More money authorized to be borrowed to finish the pier and sluice-gates. The sluice-gates now clear away so much sand, that sharp-pointed rocks show themselves, and damage the keels of vessels; the Town Council authorize 10*l.* for clearing them away.

April 5, 1791. The bulwark of the pier is very much opened out; Robert Thompson advises gravel being run into the seams: a committee ordered to apply to men of skill. The Convention of Royal Burghs granted 200*l.* for the harbour of St. Andrews. [No notice of this in the Council minutes.]

October 12, 1792. The Council authorize Dean of Guild Wallace to lay out 5*l.*, in addition to the former 20*l.*, for deepening the harbour.

December 12. The state of the harbour quays, and the road along the Abbey wall from the north pier being complained of: the estimate for the repairs 40*l.* The flood-gates' opening and shutting to be arranged by the magistrates at a reasonable rate.

Nov. 12, 1795. The road to the shore in a bad state: ordered to be repaired by the magistrates.

Jan. 21, 1797 The debts of the city have increased to such a large amount (2080*l.* 7*s.* 11*d.*) that the Council has resolved to dispose of all available property to liquidate the same; these debts have arisen from the public works at the harbour, at the church, &c., and for the support of the poor in seasons of distress, thus leaving the resources of the city quite inadequate to proceed further in any work of public utility: all dinners at elections, and every such expense to cease from this date.

March 21, 1798. The City voted 105*l.* to be paid to the Government (if any loan can be raised) in the present crisis.

Nov. 14, 1799. Another petition for deepening the habour; 20*l.* authorized for this purpose to cut down sharp-pointed rocks.

Nov. 19, 1801. The flood-gates reported to be in a bad state; a committee appointed to inspect them.

March 5, 1802. A petition from Captain Steward and other shipmasters anent deepening harbour and removing Burn Stools: the harbour should be deepened 4 or 5 feet; the vessels to be charged additional anchorage, and subscriptions to be raised for the purpose; and also to run out a bead from the end of the cross pier to prevent the accumulation of sand at the mouth of the harbour.

June 15, 1802. Deepening harbour. David Aitken's estimate for this work accepted at 20*d.* per cubic yard: work ordered to proceed, under a Committee of Inspection.

Oct. 15, 1802. The flood-gates carried away by the carelessness of David Aitken's men in deepening the harbour: the Council order them to be repaired and replaced at his expense.

Oct. 11, 1814. Report read to the Council that an application to the Convention of Burghs for 600*l.* for repairing the harbour had been successful: granted 13th July, 1814. A petition sets forth the necessity of a pier or dyke on the east side of the harbour to prevent the encroachment of the sea. The estimated expense of this pier is 1200*l.*; the town offer to raise 300*l.*, and borrow 300*l.* more, upon the assignation of the harbour dues; and they pray the Convention to advance 600*l.* under such direction and at such times as they see fit.

The harbour dues for three years 1811–12–13 . .	£130 0 0	is	£390 0 0
Harbour master's salary, 5*l.* 5*s.* for three years .	15 15 0		
Masons', carpenters', and labourers' accounts for the above three years	356 15 10	„	372 10 10
			£ 17 9 2

Therefore the free surplus for three years is 5*l.* 16*s.* $4\frac{8}{12}$*d.* each year: this abstract dated May 6, 1814.

July 4, 1815. The provost stated that the plan for improving the harbour, as proposed by Mr. Stevenson on estimate, was approved of by the Convention on 16th May, 1815: an obligation required by the city to expend 600*l.* on the work, to which the Council agrees.

Oct. 10, 1815. The Convention of Burghs recommend that an application to the Parliamentary Commissioners for Highland roads and bridges be made in aid of the works required at the harbour. Committee appointed to draw up; read to the Council 3rd April, 1816. (*See* No. 113.)

July 17, 1816. Mr. Clark produced to the Council an extract from the minutes of the Commissioners for Highland Roads and Bridges relative to the application and memorial lately presented to them by this city, requesting aid towards the repair of the harbour, which was read; the tenor is as follows:—"At a meeting of the Commissioners for Highland Roads and Bridges, May 27, 1816, the commissioners having read the memorial of the Lord Provost, magistrates, and town council of the royal burgh of St. Andrews, and having examined the map of the harbour of that place, and of the proposed improvements, and satisfied of the public utility of the design, if practicable, would willingly lend their aid towards it, provided the regulation according to which they are bound to act, should appear, upon explanation, to be compatible with the expectations of the inhabitants of St. Andrews. The principle upon which aid can in any case be afforded by the commissioners is that an equal sum of money shall first be contributed, and even then the funds appropriated to the improvement of harbours are no other than may arise from a debt due to the commissioners by the trustees of Leith harbour, an assignation of part of which must be accepted as money given by the commissioners. If these conditions do not present insuperable obstacles to the desires of the inhabitants of St. Andrews, Mr. Telford will be directed to prepare a more particular report and estimate than that which has been transmitted by the memorialists, who are requested to communicate with Mr. Hope, W.S., for the guidance

APPENDIX C.

ST. ANDREWS.

No. 114.
Notes and Extracts from Proceedings of the Town Council relative to the Harbour.

of Mr. Telford, who will be in Scotland before the end of the present summer. A letter read to the Council, signed by six persons, setting forth that no work whatever had as yet been begun at the harbour, which was in a ruinous state.

July 23, 1816. Gap at East Bents filled up. The city to pay 4*l.*

April 7, 1819. The Council having received numerous complaints that the harbour is choaked up with sand at the Cross Pier, and being of opinion that a sluice-gate would be useful if erected opposite Mitchell's fen, as originally proposed by Mr. Telford, the engineer (upon which plan the Convention of Burghs granted 600*l.*, the first instalment of which had only been paid) resolved unanimously to apply the 200*l.*, or as much thereof as may be required to the erection of the flood-gates opposite Mitchell's fen, and order estimates for the work immediately.

Oct. 12, 1821. The Council resolve to borrow 500*l.*, to be lodged in the bank, in order that they may receive the 400*l.* from the Convention, so as to proceed with the harbour repairs next spring.

July 3, 1822. The Council received estimates for the repairs of the harbour. Andrew Keay, mason, and James Hutton, wright, were the lowest. The plans and specifications were produced; the estimates were 790*l.*: the work ordered to proceed under a committee. Mr. Haig empowered to receive the 400*l.* with interest due by the Convention of Burghs.

August 10, 1822. The Council received a report from their commissioner and assessor to the Convention, that they had received 200*l.* in part of 600*l.* voted by the Convention for repairs of the harbour.

March 11, 1823. A report to be made to Mr. Stevenson of the breach in the long pier made lately by the heavy storm. Estimates to be taken in, and the work to be proceeded with as early as possible, at the expense of the town. The shore-master to levy a 1*d.* per ton on all vessels belonging to this port going above the flood-gates, and 2*d.* per registered ton on all vessels belonging to other ports, they being held liable for any damage done to the gates.

March 11, 1825. The Council received a report that a considerable portion of the harbour quay, opposite to the town's coal yard, possessed by John Foreman's heirs, had lately fallen down. Estimates were taken for the work; Andrew Keay offered to rebuild the same for 40*l.*: referred to a committee to see the work properly executed.

May 14, 1827. Mr. Smith stated to the Council that it would be of material advantage to the harbour were two wooden ladders constructed and fixed near the outer end of the north pier, and the other near the sluice gates; also if a mooring chain and buoy were laid down east from the harbour in such a situation as would enable vessels to warp out in a contrary wind. The council authorise the same to be procured, and they appoint as a committee for that purpose, Dean of Guild Mitchell, Bailie Smith, and Deacon Wemyss.

July 23, 1827. The provost then stated that the rocks eastward of the cross pier to the end of the long pier formed a great obstruction to vessels coming in to, and going out of, the harbour, and that two vessels had lately received damage thereon; he therefore moved that a committee should be appointed to ascertain the best mode of rectifying this evil. The council having considered the statement of the provost, appoint as a committee, Dean of Guild Mitchell, Bailie Smith, and Deacon Wemyss, with power to said committee to contract for the work that may be considered necessary for removing these obstructions.

March 10, 1832. The provost stated to the Council that a part of the quay opposite to Mrs. Leslie's was at present in a hazardous state, and apparently falling, and that it would be necessary to have it immediately repaired. The council having considered the provost's statement, they nominate as a committee to get the above repair executed, Bailie Kirk, Mr. George Mitchell, and Mr. Robert Pringle.

Oct. 10, 1832. It having been represented to the Council by Mr. Robert Pringle that a bank of rock, and other obstructions lying near the mouth of the harbour have occasioned great inconvenience and loss to vessels frequenting the port, and that, if the said rock and obstructions were removed, two feet more of water would be obtained into the harbour, and the expense would not exceed 15*l.* 13*s.*, the Council appoint as a committee to inspect the same, and to carry the improvement into effect, Mr. Mitchell, Mr. Edie, Mr. Robert Pringle, Bailie Kirk, Mr. James Hutton, Mr. John Thomson, and Convener Watson; Mr. Mitchell to be convener, and any three a quorum.

Sept. 8, 1834. The provost then suggested that a committee should be appointed to examine and report as to the necessary repairs to be executed on the harbour, and proposed that it should be composed of Bailie Cruikshank, Messrs. Alexander Thomson, James Gibson, William Stobie, Robert Pringle, and John Kennedy; Mr. Cruikshank to be convener, any three a quorum, and to report.

Sept. 23, 1834. Which day Bailie Cruikshank, as convener of the committee appointed by the Council to consider the state of the harbour, gave in the following report:—"The committee appointed by the council to inspect the harbour, &c., have to report, that after examining the harbour minutely, are unanimously of opinion that the rock on which the pier is built projects too far into the harbour, being in some places from 6 to 10 feet deep, with sharp corners, which are very injurious, and often attended with considerable risk to vessels going out and coming into the harbour, besides taking up a great part of it. The committee would recommend these corners to be taken off till within three feet of the pier, and curved out downwards, that the side of a vessel might lie there without being in danger of sustaining any injury. The committee would also recommend that a cut be made across the harbour, beginning about forty feet from the cross pier, running nearly in a straight line to the east corner of the sluice, cutting through the rock, placing the stones on the said straight line to face it up, and to remove the mud, &c., in front of said facing nearly to the level of the present depth of the run of the harbour, placing the mud, &c., behind said wall to bank it up. By doing so, greater space would be afforded to vessels going out and into the harbour, besides giving greater accommodation and security to vessels when in the harbour. (Signed) GEO. CRUIKSHANK, *Convener*." Which report having been read, the council authorise the magistrates to obtain a plan and specification, and to advertise for estimates to complete the repairs recommended in said report, and to have the same executed with all possible dispatch.

Feb. 20, 1835. The council having again considered the report of the committee appointed to examine the harbour, and to suggest any improvement that may appear to them to be necessary, they

APPENDIX C.

ST. ANDREWS.

No. 114.
Notes and Extracts from Proceedings of the Town Council relative to the Harbour.

authorise the magistrates to advertise for estimates to have the work as shown from the plan executed, and to cause proper specifications to be prepared in terms of that plan; such estimates, when so lodged, to be reported to a future meeting of the council. The Council add Mr. Smith to the committee, formerly appointed to inspect the harbour.

Feb. 27, 1835. The Council authorise the harbour committee to correspond with Mr. Leslie, civil engineer, Dundee, as to the best plan to be adopted in executing the proposed repair on the harbour, and, if necessary, to bring him to St. Andrews to inspect the same, and suggest any improvements that he may think proper, so as no injury may be done by such operations to the foundation of the long pier.

May 23, 1835. Which day, Bailie Langlands stated this Council had been called for the purpose of opening the estimates lodged for the deepening and improving the harbour; and the estimates lodged having been opened, the first was by Thomas Terras and Walter Scott, offering to execute the work in terms of the plan and specifications at the sum of 220*l.*; the second by William Graham, road contractor, offering to execute the said repairs in terms of the said plan and specifications thereof, for the sum of 186*l.* 16*s.* 3½*d.*; and the third by James Mitchell, mason, St. Andrews, offering to execute the work in terms of the plan and specifications, for the sum of 227*l.* sterling. Which estimates having been considered by the meeting, they accept of the estimate lodged by William Graham, to execute the work for the said sum of 186*l.* 16*s.* 3½*d.*, upon the express condition, that he shall find sufficient caution to the satisfaction of the magistrates for the due execution of the work; and appoint as a committee to see the work carried into effect, in terms of the plan and specifications, Messrs. James Gibson, Robert Pringle, and Thomas Wemyss.

Sept. 1, 1835. A Committee ordered to rebuild the stairs at the north-west corner of harbour.

Dec. 29, 1845. Ordered by the Council that the charge for vessels laying up in the harbour during the winter be 1½*d.* per ton, whatever the amount of tonnage. Report of a Committee assembled on the state of the harbour, 14th Nov. 1845.

The Committee recommend rebuilding the west wall of the harbour and widening the quay; also brandering the outer harbour and top planks for the security of carts.

A moveable crane should be supplied to the harbour on east side of the harbour. The Committee recommend that the corner north-east of the gates be enclosed with a wall leading from the stone pawl to the south end of the cross pier, and that the space east of this should be filled up level with the gates.

No. 115.
Return of Income and Expenditure for the Years 1842, 1843, 1844.

No. 115.

Return of Income and Expenditure for the Years 1842, 1843, *and* 1844.

Income.	1842.			1843.			1844.			Expenditure.	1842.			1843.			1844.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Anchorage dues . .	38	13	2½	41	3	6½	37	19	10¼	Collector's salary	20	0	0	20	0	0	20	0	0
Shore dues . . .	125	1	9¼	131	18	11	118	14	10½	Repairs on pier and quay . .	3	17	6½	14	10	2	19	10	0
										Cleaning out harbour . . .	2	3	7	5	13	6	3	14	1
	163	14	11¾	173	2	5½	156	14	8		26	1	1½	40	3	8	43	4	1

N.B.—The revenue is levied by authority of the magistrates of St. Andrews.

FERRY PORT ON CRAIG.

No. 116.
Return to Address of the House of Commons of 29th July, 1844.

FERRY PORT ON CRAIG.

No. 116.

Return to Address of the House of Commons of July 29, 1844.

Ferry Port-on-Craig, April 19, 1847.

Receipts, year ending at Martinmas	1842.	1843.	1844.
Dues on vessels . . .	£ 7 14 9	£12 8 0	£13 0 0
Ditto on goods . . .	24 1 11	20 12 6	29 18 0
Total	£31 16 8	£33 0 6	£42 18 0

Expenditure.

Repairs, none of any importance during the above periods.

Expense of collecting dues, say 15*l.* per annum. This cannot be accurately ascertained, as the dues are let along with other subjects.

The right of harbour is conferred by Royal Charter, and the dues are levied in virtue thereof.

W. STARK DANGALL.

117.
y Report
ty Ferry.

No. 117.

Admiralty Report on the Edinburgh and Northern Railway Improvement of the Ferry between Ferry Port on Craig and the north side of the River Tay.

Admiralty, March 1, 1847.

ASSENT will be given to this project on the following conditions:—

1st. That on the south side of the Tay no structure shall project into the river beyond a line

APPENDIX C.

FERRY PORT ON CRAIG.

No. 117.
Admiralty Report on the Tay Ferry.

drawn from the outer extremity of the passage pier, marked in the deposited plan, extending in a direction to the eastward tangent to Tentsmuir Point.

2nd. That on the north side of the Tay no structure shall project into the river beyond a line drawn from high-water mark at Broughty Castle, extending in a direction westward, to the outer extremity of the wooden jetty marked on the deposited plan.

3rd. That the ferry-boat used shall be a free boat—that is, not attached to a chain.

4th. That the ferry-boat shall not cross with any vessel in tow.

5th. That the ferry-boat shall not cross between the hours of sunset and sunrise, except under such regulation with respect to lights as shall be approved by the Admiralty.

H. G. WARD.

WOODHAVEN.

No. 118.

Return to Address of the House of Commons of 29th July, 1844.

WOODHAVEN.

No. 118.
Return to Address of the House of Commons of 29th July, 1844.

St. Fort, Newport, Fife, 17th December, 1846.

SIR,

IN compliance with your letter of 15th November last, desiring me to prepare a return, so far as relates to the pier or harbour of Woodhaven, belonging to me, in pursuance of a Resolution of the House of Commons, dated 29th of July, 1844, I have to state that the said harbour and dues are let; and the following is the report of the tenant for all imports and exports for the last three years, ending at Martinmas of each year, viz:—

1842	£ 2 17 7
1843	3 18 0
1844	11 18 5

The imports consist of coals, stone pavement, end drain-tiles. The exports, wheat, barley, potatoes, and railway sleepers.

The authority by which the above harbour dues are levied is by Crown charter and immemorial usage.

I have to state, that there has not been any account kept of the expenditure in reference to the harbour, for the foresaid three years, but I hold an estimate amounting to 50*l.*, required for repairs on Woodhaven pier and harbour.

I have, &c.,
H. STEWART.

The Hon. H. Manners Sutton.

NEWPORT.

No. 119.

Return to Address of the House of Commons of 29th July, 1844.

NEWPORT.

No. 119.
Return to Address of the House of Commons of 29th July, 1844.

Tayfield, by Newport, Fife, 12th December, 1844.

SIR,

IN compliance with your letter of 15th November last, desiring me to prepare a return, so far as relates to the pier or harbour of Newport, belonging to me, in pursuance of a Resolution of the House of Commons, dated 29th July, 1844, I have to state that the payments made to me for the three years preceding the date of your letter, by the collector I employ for receiving the harbour dues at Newport, have been made *in cumulo*, without distinguishing the different heads of income, of which no account specifying the same has been kept, but these dues are collected according to the following rates, viz.:—

Harbour Dues.

For every vessel	Two placks Scots, or two-thirds of a penny sterling, per ton.
Fishing boat, for anchorage	Sixpence sterling.
Pleasure boat, ditto	Sixpence sterling.

The shore dues on goods, with a few exceptions, are regulated by the Dundee table of rates previous to the original Act for improving that harbour.

The sums paid to me by the collector were, 7*l.* in 1842, 9*l.* in 1843, and 4*l.* in 1844. The authority by which the dues are collected is by charter and immemorial usage.

No account of the expenditure on the harbour has been kept; but the outlay for maintaining the pier during these years may have been about 3*l.*

WILLIAM BERRY.

Honourable H. Manners Sutton.

APPENDIX C.

BALMERINO.

No. 120.
Return to Address of the House of Commons of 29th July, 1844.

BALMERINO.

No. 120.

Return to Address of the House of Commons of 29th July, 1844.

Income.	1841			1842			1843			Expenditure.	1841			1812			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Tonnage and anchorage dues, at 1*d*. per ton	4	7	3	5	16	4	5	19	5	Sundry expenses .	0	19	6	1	15	0	2	5	0
Dues on goods, at 2*d*. per ton . .	3	2	6	4	15	4	5	6	4										
Sundries	1	17	10	3	1	2	3	11	4										
	9	7	7	13	12	10	14	17	1		0	19	6	1	15	0	2	5	0

Authority granted by the Barons of Exchequer, in 1755, to the predecessor of the present proprietor F. A. Stuart, Esq.

December, 1844.

ROBERT RENTOUL, *Lessee*.

WEST NEWBURGH AND NEWBURGH.

No. 121.
Return to Address of the House of Commons of the 29th July, 1844.

WEST NEWBURGH AND NEWBURGH.

No. 121.

Return to Address of the House of Commons, of the 29*th July*, 1844, *from Newburgh and West Newburgh.*

Income.	1841			1842			1843			Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Shore dues, (West Newburgh) . .	90	0	0	86	0	0	88	0	0	Rent and repairs .	49	0	0	45	0	0	48	0	0
Shore dues, (Newburgh) . . .	81	0	0	77	0	0	79	0	0	Rent and repairs .	41	0	0	37	0	0	38	0	0

JOHN DICKMAN, *Lessee at West Newburgh.*
ANGUS CAMERON, *at Newburgh.*

PERTH.

No. 122.

No. 122.
Evidence taken on the 1st October, 1846.

Examining Commissioner, Captain WASHINGTON, R.N., *assisted by* Captain VETCH, R.E., F.R.S., *Admiralty Engineer.*

Present:—The Lord PROVOST; the Right Hon. FOX MAULE, M.P.; the Dean of GUILD; Bailies, KEAY, CLUNIE, R. & W. GREIG; Councillors, WALLACE, SHEDDEN, BLAIR, W. & P. IMRIE, GRAY, LAMONT; Mr. MOUNT, *Treasurer*; Messrs. M'LIESH, MURRAY, M'FARLANE, BALLINGALL, Messrs. COWPERTHWAITE, J. GRAHAM, DOW; Mr. D. STEVENSON, C.E.; Professor ANDERSON; Dr. BARLAS; Mr. WEDDERSPOON, Clerk to the Harbour Commissioners; Mr. REID, Town Clerk; Mr. P. CHAPMAN, *Treasurer*; Mr. GARIE, Harbour Master; Mr. MORRIS, Collector of Shore Dues, &c.

[*The plan of the River Tay and harbour of Perth, made by Messrs. Stevenson, C.E., in* 1834, *on the scale of* 6 *inches to a statute mile, and presented by them to the Harbour Commission, was laid on the table.*]

The COMMISSIONER opened the proceedings by reading the Royal Commission, and stated that this was an inquiry into the past and present state of the river Tay and the harbour of Perth, and as to its capabilities for further improvements. He had that morning, in company with Captain Vetch and the harbour master, visited and inspected the river and tidal basin, and the spot at which it was proposed the railway bridge should cross. He also mentioned that, in the year 1844, he had had occasion officially to examine the whole course of the Tay, including the site of the once proposed railway viaduct at Mugdrum, and more especially the sand-banks at the entrance of the river. The Commissioner further stated that the present meeting was public, and that, after taking the evidence of the officers of the trust, and of the engineers, they would be ready to hear the remarks, opinions, or suggestions of any merchants, sailors, or other person interested in the welfare of the port.

Mr. D. WEDDERSPOON examined.—Had been clerk to the harbour commission since 1830. The harbour is governed by three Acts of Parliament, namely, 11 Geo. IV., and 1 Will. IV., cap. 121; 4 & 5 Will. IV., cap. 67; and 2 Vict., cap. 21; these acts appointed thirty commissioners, three of whom to be shipowners; gave power to levy dues, and to borrow money to the amount of 50,000*l.* on the security of the rates. Prior to the passing of the Acts the affairs of the port and harbour o Perth and the interests of the navigation of the Tay were in the hands of the magistrates of the city of Perth, in virtue of certain rights of free port and harbour, and of certain powers and privileges as conservators of the Tay, conferred upon them in early times by Kings of Scotland, and which were confirmed by a Charter of King James VI., as well as by a subsequent decree arbitral pronounced by the same monarch, both of which were ratified by an Act of the Scottish Parliament, dated the 9th July, 1606; but those rights did not give power to levy increased dues, or to take land in order to improve the river, and therefore the community had applied for the above-named acts. The rights, powers, privileges, and jurisdictions so vested in the magistrates of Perth. were, however, saved and reserved by those Statutes under which the harbour commissioners now Act. The quays were originally erected by the city, but under the new Acts they have been repaired and extended. A harbour had been begun and proceeded with to some extent, but left unfinished from want of funds, and the river had been deepened by dredging as far down as Newburgh. There are thirty commissioners under the Act:—the Member for the city, fourteen of the town council, six commissioners of supply, three shipowners, and six burgesses of Perth. The Act does not require any sailor on the commission. The amount of shore dues in 1845 was 4224*l.*, of which one-twelfth is paid to the town of Perth in lieu of their right to levy dues under their Charters. The proprietors of certain shipping-places in the Tay claim an exemption from dues on the produce of their own lands when exported, and on manure, coals, &c., when imported for the use of their estates. One great hindrance to improvement has been caused by the proprietors of the salmon fisheries in the river, all of whom claimed compensation for supposed injury. A sum of 5000*l.* for temporary damage has been paid to different individuols, and a final sum, not yet settled, is shortly to be decided upon and paid as permanent compensation. The large sum of 61,917*l.* 18*s.* 4*d.* has been laid out in improvements, besides the interest paid on debt, which is 19,233*l.* 9*s.* 9*d.* A detailed plan of the river has been made by Messrs. Stevenson, and on this the improvements of the river were based. Additional room is still wanting, as at one time forty vessels had been seen in the port, and it was very desirable to obtain increased accommodation. But n portion of the funds that might have been expended with this object, the commissioners have unfortunately felt themselves repeatedly compelled to devote to an endeavour to preserve this fine river from being crossed by a railway bridge at Mugdrum, and at points higher up. In order to defeat these projects, they engaged the services of Mr. D. Stevenson, who had carefully examined into and fully reported on the question. At the same time the Perth commissioners could not but feel that it was a great hardship that the Government of the country, which claimed jurisdiction over all navigable rivers, should leave the task of defending the Tay to the city of Perth, and imposed the expense of such defence upon their limited funds.

As far as witness was aware the community were quite satisfied with the constitution of the harbour board; there were no complaints against it, and the seafaring interests were secured by a provision in the Act which makes it incumbent that three shipowners shall always be members of the board.

Mr. J. GRAHAM begged leave to demur as to the alleged proper balancing of parties on the harbour board, as well as to the unqualified satisfaction that it was said to have given. He admitted the great good that had been done in deepening the river, but he denied that all had been done in this respect that might have been effected. As a shipowner he complained that only three of his class were entitled to sit at the board. He commented upon the great want of room at the shore, partly occasioned by allowing a large sandbank to remain and accumulate right opposite. He had often exerted himself for its removal without success, which would not have been the case had there been more shipowners or sailors at the board who were practicallly acquainted with the wants of shipping. There should be at least six shipowners or sailors on the board. The salmon fisheries are a great obstacle to improvement, and one which certainly should not be permitted to exist.

APPENDIX C.

PERTH.

No. 122.
Evidence taken on the 1st October, 1846.

Mr. DOW.—As a shipowner, fully concurs in what has been stated by the preceding witness as to the want of shipowners and seafaring men on the harbour board. If the shipping interest had been better represented more trouble would have been taken to obviate the general and well founded complaint of want of room.

Mr. BALLINGAL said it was hardly fair that the harbour commission should be attacked for not doing what it was well known they had no funds to do. They must wait for the decision respecting compensation for damage to fisheries; the funds of the city were bound for the whole amount of compensation.

Mr. BLAIR agreed with the last witness that it was unjust to attack the harbour commission. Although the act made it imperative that there should be three shipowners, members at all times, it did not preclude there being more shipowners on the board; in fact, at this moment, there were no fewer than seven shipowners members of the commission. The sandbank in question was only allowed to remain from want of funds to remove it.

Mr. J GRAHAM admitted that there was a want of funds, but at the same time he was of opinion that had there been a great desire to remove the bank it might have been accomplished. Where there's a will there's a way.

Mr. WEDDERSPOON.—The town council claim to be conservators of the river as a distinct body from the harbour commission. These bodies had sent up witnesses to the House of Commons to oppose the Bill for crossing the Tay, and they had been put to the expense of 3000*l*. by the various railway projects. Had the veto of the Admiralty been given earlier, a great part of the expense could have been saved. In common justice, the railway companies should be compelled to pay this expense. The contest is not yet finished; it is still uncertain how or where the Tay will be crossed; and any crossing will be opposed by the city of Perth that is below the harbour, or that can interfere in any way with the navigation of the river.

Dr. BARLAS entirely coincided in these remarks, and it appeared to him a very hard case indeed that parties should be compelled, at great sacrifice, to protect their property from the encroachments of bodies whom either whim or caprice, or anything else, might lead to appropriate it to their own purposes.

Mr. Patrick CHAPMAN.—Has been treasurer to the commission since first obtaining the Act in 1830. He gives security for his place. The accounts are laid before the board, and audited annually by a committee of the board; the balance sheet is not printed nor published. The amount of revenue, on an average of the last four years, was 3581*l*. 1*s*. 10*d*. There is a debt due to private creditors, who receive interest at the rate of 4 per cent.; and a fluctuating balance due to the Perth bank, on which interest is charged at the rate of 5 per cent. The whole debt is 43,070*l*. It would be a great boon if Government could be induced to lend money, at a low rate of interest, to pay off harbour debts incurred in works for the good of the public. Produced the treasurer's books.

The COMMISSIONER having examined the minute book and the treasurer's account, said, as far as a cursory inspection would enable him to judge, the minute book and account book were correctly and carefully kept, and were alike creditable to the clerk and treasurer of the harbour commission.

Mr. D. STEVENSON, C.E.—The Messrs. Stevenson were first called in to examine the river Tay in 1833. Made a detailed chart of the river from Perth to Invergowrie and Balmerino, with soundings to Newburgh, a distance of 8 miles from Perth, and fully reported on the state of the river on the 22nd July, 1834. At that time there was a depth of from 11 to 14 feet at high-water springs up to the tide harbour. At Darry and Mugdrum especially, the channel was then much filled by shoals which have since been removed by dredging; boulder stones of large size, and fords have been taken away; directing walls have been built; back channels have been shut up; and the current on flood and ebb induced to run in the same channel. By these means a depth of 15 feet throughout has been obtained; the flood tide has been brought up fully 50 minutes earlier to Perth bridge, and the duration of the tide prolonged; and a million of cubic yards of water in addition pass Newburgh on every tide. Although much had been effected, all the works that had been designed at first had not yet been accomplished. The shipping interest cry out loudly for the tidal basin or harbour to be completed, which has been stopped from want of funds. From the great quantity of ice in the river during winter, such a harbour is urgently called for, as vessels could not then lie at the shore without sustaining much damage. Is of opinion that the tidal basin should, if possible, be proceeded with, although it should be only for 100 yards at a time; the cost of such an extension, including a quay on one side, would be 1800*l*. per 100 yards. There is a tendency in the river to fill up at the bottom of Willowgate, and some of the fords have risen since the river was deepened; but the only remedy for this is the occasional application of the dredge. Certain water-pipes cross the river just above the harbour. Some of the quays are built of concrete: they have stood well. The stone quays were built by Mr. Jardine; the foundation is barely deep enough to admit of further dredging; the timber quays are very much out of order and require repair. Although much has been done, the river is susceptible of far greater improvement; nothing but want of funds prevents its being deepened to 19 or 20 feet of water up to Perth; the cost of this would be about 50,000*l*. The average slope of the bed of the river is still 5 inches a mile from Perth to Balmbreich, and 10 inches a mile from Newburgh downwards; by equalising this fall the tide would be brought up earlier. The tide flows 2½ miles above Perth bridge to the junction of the Tay with the Almond.

With reference to the proposed bridge across the Tay at Mugdrum, is of opinion that it is a wild scheme, and will never be carried out; every one of the four schemes proposed is prejudicial to navigation. As many as 940 vessels arrived, and as many sailed from the port of Perth during the last year; and the whole of this trade would be subject to inconvenience, to say the least of it, but most probably to positive danger at times. It would impede the navigation; and although a lofty arch 92 feet high, or a drawbridge were placed across the deep-water channel, who could guarantee that the channel would remain under the arch; it is highly probable that the works themselves might divert the stream, alter the channel, and cause shoals, but would rather refer to his printed report on this subject, dated 7th January, 1845. (See Appendix, No. 127.)

The LORD PROVOST asked, with respect to the crossing proposed at the South Inch, whether Mr. Stevenson is of opinion that if the bridge be placed on a skew, it might cause the washing away of the point of Moncreiff island.

Mr. STEVENSON could not say so upon a superficial glance of the plan, which was all he had had an opportunity of seeing; but he thought there could be no doubt that such an erection would tend to withdraw the water from the pier side of the river.

APPENDIX C.

PERTH.

No. 122.
Evidence taken on the 1st October, 1846.

Captain VETCH observed that such being the case, it was enough to justify objections on the part of the harbour commissioners, without reference to the effects on the island.

Professor ANDERSON was decidedly of opinion that the crossing above the water-pipe would be best; the river Tay has been known to rise from 10 to 12 feet in twenty-four hours; in a recent fresh on the 15th December, 1845, the water rose to be 3 inches deep on the quay. Many inhabitants of Perth remember seeing a vessel laid on the quay by the spring tides and a fresh in 1814; in the year 1796 there were similar floods. The Tay is too important a river to be trifled with; it drains an extent of 2283 square miles of country; and its main discharge is 218,158 cubic feet per minute; that of the river Earn, which falls into the Tay, is 54,959 feet;—making together 273,117 cubic feet per minute. The proportion of water running down the Willowgate branch, bears to the whole water flowing in both branches in the ratio of 12 to 37. (See Report, Appendix No. 124).

Mr. GARIE.—Has been eleven years harbour or berthing master at Perth; and before that, twenty years at sea. The arrivals at the port of Perth were 940 vessels last year, and as many sailings; has known fifteen vessels come up on a single tide under sail; if a bridge had existed at Mugdrum, it is probable, unless the wind had been quite fair, that the time required in passing through would have made the few last lose their tide up to Perth. Has seen forty vessels in the harbour at one time. Confirmed all former witnesses stated as to the want of berthage; of the necessity of removing the middle bank, and of the shelf off Friarton island. Vessels drawing 14 feet can come up to Perth. The rise of tide at Perth ranges from 14 feet on extreme springs to 6 feet on neaps, and the time of high water at full and change is 3h. 55m. The stream runs from 2m. to 2½m. ordinarily, but from 4 to 5 knots in freshes. There is one tidal basin with an area of 2¼ acres; and including the river, about 2000-feet of quays in all; there are two cranes, one capable of lifting six tons, the other three tons; there are twelve building slips, six of which are occupied, at present employing about 100 shipwrights, there are two foundries for casting and repairing machinery; two steam-tugs,—one of 28, the other of 30-horse power; besides the river steamers trading daily to Dundee. The tonnage of sailing-vessels belonging to the port, including the creek of Newburgh, is 10,000 tons. Of the 940 arrivals of last year 1000 tons were foreign, and 45,000 tons coasting. There is one dredging machine of 12 horse power; when it is at work about 690 tons of soil are dredged per day; the cost of raising which, exclusive of the machine and wear and tear, is 1½*d.* per ton. The quays are partly of stone from the quarries at Kingoodie, and partly of larch timber; they are not bored by any insect There are two pilots belonging to the port, licensed by the Trinity House of Leith. The buoys and beacons in the upper part of the Tay are not considered sufficient. The work most required for the benefit of the port is the completion of the tidal basin and the removal of the banks above mentioned.

The COMMISSIONERS having asked if any one present had any further remarks or suggestions to offer, said that they believed that all the most material points connected with the port of Perth had come under their notice. They could not, however, close the inquiry without expressing their gratification at a few facts which had been elicited in the course of the investigation. And first, as it was the foundation of all the rest, at the good judgment and foresight evinced in having caused an admirable survey and plan of their river to be made, and in consulting a first-rate engineer, and following his advice; secondly, at the liberality they had shewn in expending more than 60,000*l.* in improvements; and lastly, at the public spirit and persevering energy with which they had resisted the several attempts of a reckless railway company to place a viaduct across one of the noblest navigable rivers of the United Kingdom.

(*Adjourned.*)

No. 123.

Return to Order of the House of Commons of the 9th August, 1844.

No. 123.
Return to Order of the House of Commons of the 9th August, 1844.

SIR,

Perth, February 11, 1845.

IN compliance with the requisition contained in your circular letter of date the 1st instant, I beg to state that the titles of the several Statutes under which the harbour commissioners of Perth have acted, and now act, are the following:—

1st. 11 Geo. IV., and 1 Will. IV., cap. 121, intituled "An Act for enlarging, improving, and maintaining the Port and Harbour of Perth, for improving the Navigation of the River Tay to the said City, and for other purposes therewith connected." (Royal assent, June 17, 1830.)

2nd. 4 and 5 Will. IV., cap. 67, intituled "An Act to alter and amend an Act passed in the eleventh year of the reign of His late Majesty, and first year of the reign of His present Majesty, intituled "An Act for enlarging, improving, and maintaining the Port and Harbour of Perth, for improving the Navigation of the river Tay to the said City, and for other purposes therewith connected." (Royal assent, June 27, 1834.

3rd. 2 Vict., cap. 21, intituled "An Act to alter, amend, and enlarge the powers and provisions of two several Acts of the eleventh year of the reign of King George IV., and first year of the reign of King William IV., and fourth and fifth of the reign of King William IV., for improving the Port and Harbour of Perth, and the Navigation of the River Tay to the said City." (Royal assent, June 4, 1839.)

Before the passing of these Acts, the affairs of the port and harbour of Perth, and the interests of the navigation of the Tay, were attended to by the magistrates of the city of Perth, in virtue of certain rights of freeport and harbour, and of certain powers and privileges as conservators of the Tay conferred upon them in early times by the Kings of Scotland, and which were confirmed by a Charter of King James VI., as well as by a subsequent decree arbitral pronounced by the same monarch, both of which were ratified by an Act of the Scottish Parliament, July 9, 1606.

The rights, powers, privileges, and jurisdiction so vested in the magistrates of Perth, were saved and reserved by the statutes above recited, under which the harbour commissioners now act.

I send you herewith copies of two printed reports by Messrs. Robert Stevenson and Son, the engineers employed by the harbour commissioners, the one dated 22nd January, 1834, and the other 7th January, 1845, and which contain full particulars as to the past and present state of the port and harbour of Perth, and the navigation of the Tay. To the first of these reports are appended, 1st, an engraved plan or survey of the river Tay from Perth to Invergowrie and Balmerino, with numerous soundings from Perth to Newburgh, a distance of ten miles; and 2nd, a plan and sections

Appendix C.

Perth.

No. 123.
Return to Order of the House of Commons of the 9th August, 1844.

of the harbour of Perth, authorised to be executed by the foresaid Acts. To the second report is appended a plan with sections of the rivers Tay and Earn, on which are noted the depths of water, the direction and velocity of the currents and other particulars. These reports and plans it is believed will be found to embrace all the information required for the purpose referred to in your circular.

Before the commencement of the statutory operations, vessels navigating the Tay were subjected to much inconvenience owing to obstructions in the fairway occasioned by fords and boulder stones, and the want of suitable accommodation for them while in port. The execution of the statutory works, as far as they have already proceeded, has had the effect of removing the obstructions to the navigation; and the only complaints now heard, and which are made verbally to the harbour master, refer to the want of sufficient quay room; but this ground of complaint will also be removed, when the works still remaining to be executed are completed.

I am, &c.,
David Wedderspoon.

The Hon. H. Manners Sutton.

No. 124.
Dr. Anderson on the discharge of the Tay.

No. 124.

Report by Dr. Adam Anderson *on the Discharge of the Tay*, 1831.

In obedience to the remit made to me by the Honourable the Sheriff of Perthshire, of date the 12th day of January, 1831 years, in the application presented to him by the Clerk to the Commissioners under the Perth Navigation and Harbour Act, I proceeded to ascertain the relative quantity and proportion which the water running down the Willowgate branch of the Tay bears to the whole water at a medium state of the river flowing in both branches thereof; and from the accompanying sections of the two branches of the river measured, drawn, and computed by me, and to which reference is hereby had, I am enabled to report that the discharge by the Willowgate Channel bears to the whole discharge of the river the ratio of 12 to 37. The various measurements for the purpose having been made with considerable care, and all the calculations having been duly checked, I venture to say that the result affords as accurate an estimate of the point to be determined as the nature of the case admitted. As much inconvenience often arises from the disjunction of plans and explanatory memorials, I have inserted, in the same sheet with the sections, a concise, but, I trust, a clear statement of the methods I employed both for obtaining the requisite data, and for afterwards deducting from them the actual discharge of the river in cubic feet per minute. Those interested would thus have been enabled to judge of the degree of accuracy of which the method was susceptible for the attainment of the object in view, while the groundwork of the calculation would present a record of the state of the river at the time my experiments were made. The necessary measurements having been enjoined by the Act to be taken at the "*medium state of the river,*" a form of expression which, though sufficiently precise for ordinary purposes, admitted of considerable latitude of interpretation by different individuals, I was anxious to ascertain, upon general principles, how far the state of the river on the day I took my measurements agreed with the conditions referred to, and accordingly, on making a computation of what ought to be the quantity of water discharged by the river in its mean state, it gave me much satisfaction to find that it coincided very nearly with the results of my measurements. This coincidence authorised me to infer that in that respect the stipulation of the Act had been complied with. I have heard it asserted by different persons that the quantity of water flowing through the Willowgate this season exceeded the average quantity of former years; but on this point I did not feel myself at liberty to make any allowance.

(Signed) Adam Anderson.

[The Tay drains an area of about 2283 square miles: the discharge of the river is—Tay 218,158 cubic feet per minute; Earn, which discharges into the Tay, 54,959; together 273,117 cubic feet per minute.]

No. 125.
Stevenson, on improving the Navigation of the Tay between Perth and Newburgh, and making a Tide Harbour and Wet Dock at Perth; and Estimate.

No. 125.

Messrs. Robert Stevenson and Son *on improving the Navigation of the Tay between Perth and Newburgh, and making a Tide Harbour and Wet Dock at Perth; and Estimate.*

Edinburgh, January 22, 1834.

The city of Perth is calculated, in a remarkable degree, to become the seat of numerous manufactures and extensive traffic. Its situation on the banks of a great navigable river, stretching far into the interior of the country, places it in the centre of a rich and populous district, and constitutes it the natural emporium of the central part of Scotland. The great extent, also, of level and fertile country, which lies beyond it in every direction, though much in want of an easy and expeditious communication with shipping for the transport of its produce and imports, affords great inducements for improving the means of its internal intercourse, in the facility which would attend the formation of railways or canals. With such advantages, the defective state of its harbour is the only circumstance which retards the advancing prosperity of Perth, and it has accordingly long been a desirable object with the community to improve the port, by rendering it more accessible to trading vessels of the ordinary class, and providing quays for enabling them to lie in safety.

It is well known to the public, that the magistrates of Perth have long and zealously laboured for the promotion of this object; and it may be noticed, that the services of Smeaton and Rennie, the most celebrated engineeers of their time, were successively called for. The former of these eminent men, consulting the natural course of the river in connection with the design of his bridge, projected a line of quays upon a scale suited to the trade and berthage of the craft then frequenting the port; while Mr. Rennie, seeing the increasing prosperity of Perth and the neighbouring districts, and aware of the discomfort and even danger which attend vessels lying along quays in a rapid current, proposed a suite of wet docks on the South Inch.

The excavation of these docks, and the execution of other harbour works, seem to be fully warranted by the facilities which Perth holds out for the extension of her manufactories, and for the agricultural improvement of the neighbouring county, by the projection of extended lines of railway into the valleys of Strathmore and Strathearn, and through the county of Fife. These measures are calculated

APPENDIX C.

PERTH.

No. 125.
Stevenson, on improving the Navigation of the Tay between Perth and Newburgh, and making a Tide Harbour and Wet Dock at Perth; and Estimate.

to produce important and beneficial changes; but their execution is retarded by the unimproved state of the harbour of Perth. In proof of this, the Reporters need only allude to the practical example of the neighbouring port of Dundee, whose harbour had no sooner begun to be extended, than a railway was projected into the valley of Strathmore, under circumstances of the most inauspicious kind.

The great bar to the improvement of the harbour of Perth, has been the fear of deteriorating the value of the salmon fishings, by any extensive operations for facilitating the navigation of the river. To avoid interference with the fishings, measures of a remote and feeble kind have from time to time been resorted to; and until this objection against any changes on the bed and course of the river between Perth and Newburgh be overcome, it is worse than useless to undertake expensive improvements at the town, the benefits of which must be entirely frustrated by the state of the navigation below.

It has been said that the navigation of the Tay is an object of greater public importance than the salmon fishings, and that the rights of the conservators of the river are naturally of anterior date to those of the fishers. This is a point upon which the Reporters do not consider themselves competent to offer any opinion, and it has been already acutely discussed by one of the town clerks of Perth, in an able disquisition modestly entitled "Observations." Independently, however, of this view of the question, the claims of the proprietors of the fishings may be fully met by a proposal of a similar nature to that which is daily made by public trusts, in dealing with the proprietors of the soil, for leave to make road and harbour improvements, in which they agree to remunerate the proprietor for any damage he may eventually sustain. In the case of fishings, the extent of damage cannot *a priori* be ascertained, but must proceed upon a retrospective average of the produce of several years after the proposed changes have been executed, in the same manner as was done upon the river Dee, where one of the Reporters was professionally employed. As a proof of the justice and safety of such an arrangement, it will be satisfactory for the magistrates and town council to know, that in no instance has the award been demanded which was provided for in the Aberdeen Act; the fishings having actually increased instead of being diminished since the extension of the harbour works. Such, also, the Reporters have no doubt will be the case in any arrangement which may ultimately be entered into with the proprietors of the salmon fishings on the Tay.

It has been apprehended that the operation of deepening the fords of the river by dredging, would have the effect of disturbing the fish, or changing their habits. Similar fears were entertained regarding the effect of the constant passage of steam-boats in connection with the dredging operations upon the Clyde, which many feared would have been fatal to the fishings of the river. Experience has, however, shewn the groundless nature of such alarms; and the continued operation of no fewer than four dredging machines and two diving-bells, besides the daily traffic of upwards of sixty steam-boats, which during a great part of the day, make not fewer than twenty passages in an hour on the track between Glasgow and Greenock, has so little affected the fishings, that their produce is said not to have been sensibly diminished.

Similar facts regarding the salmon fishings of the Dee, the Tyne, the Tees, the Humber, and the Thames, have also been ascertained from the experience of several years, after the execution of important changes in these rivers; and the Reporters have of late had some communications from these quarters on this subject, which corroborate the observations they have now made. It is true that the fishings on all these rivers, particularly those in the south, are inconsiderable compared with those of the Tay; but the result of the information which has been obtained, shews, that the fishings, such as they are, have not sensibly diminished since the introduction of steam navigation; and that none of the operations connected with the improvement of Aberdeen harbour, or of the navigation of the estuaries above mentioned, have affected the produce of their fishings. The Reporters, proceeding upon so wide a range of evidence, conclude that a satisfactory arrangement may be made with the proprietors of the fishings on the Tay, so as to permit the harbour trust of Perth to undertake the improvements of the navigation of that river upon an efficient scale.

The magistrates and town council are already aware that certain ridges, called fords, lie across the bed of the river, between Perth and Newburgh. These fords are found to obstruct the navigation to such a degree, that loaded vessels of ordinary tonnage, drawing from 10 to 11 feet of water, can only make their way to the quays of Perth during spring tides, and even then not without great difficulty; while vessels, missing the few days of high tides, lose a fortnight in waiting for the following springs. In this way, the freight of ships to Perth is greatly enhanced, as a moderate rate will not cover such casualties: and mariners are therefore induced, as much as possible, to avoid the port, both on account of the uncertainty of the navigation, and the damage which their vessels often receive in their passage up the Tay. But the trouble and delay in the navigation of the river are not the only objections which attend the port of Perth. There is no provision for the safety of vessels after they reach their moorings, and from want of proper accommodation they must lie in the stream, exposed to the rapid winter currents of the Tay, and to danger from the breaking up of ice in floods. They are therefore not only in danger of breaking adrift, but of being laid *high and dry* upon the roadway of the quay. Under all these disadvantages, Perth is anything but a desirable port to the mariner; and though a few coasters, who make the town their home, continue to frequent it, it is not a very general resort of foreign or even coasting vessels. The merchants are thus either cramped in their traffic, or obliged to form connections at places below the fords, from whence their goods are chiefly transhipped in lighters—a method of conveyance which is very disadvantageous from its uncertainty, and the continual disappointment and extra expense which attend it; and, while the neighbouring ports carry on a prosperous trade, in a narrow and comparatively unimportant district, the commerce of Perth, under many local advantages, languishes from the want of a commodious harbour.

The present state of the navigation of the Tay, will appear from the accompanying plan and section of the river, marked No. 1, which have been made from a trigonometrical survey, and from the soundings whose depths were determined in reference to the state of the tide, ascertained by a register of rises on tide-staffs, at different places. The positions of the soundings were fixed by sextant observations.

With regard to the nature of the works to be undertaken for the improvement of the access to the harbour, it will be seen, from the section and plan No. 1, that the bed of the river between Newburgh and Perth is much encumbered by the fords alluded to. These fords are, Sleepless ford at the upper end of Sleepless island, Millhurst opposite Darry island, Seggieden at Balhepburn island, and Kirwhinnel above Mugdrum island. When the river is in its state of summer water, especially at low

APPENDIX C.

PERTH.

No. 125.
Stevenson, on improving the Navigation of the Tay between Perth and Newburgh, and making a Tide Harbour and Wet Dock at Perth; and Estimate.

spring tides, some of these fords are nearly dry, while others are permanently under water. The depths upon them, at high water of a spring tide of 8 feet rise at the new quay of Perth or 12 feet at Newburgh, vary from 11 feet 9 inches to 13 feet 9 inches, and at neap tides from 7 feet 9 inches to 9 feet 9 inches, or thereby. It thus appears that a very limited range of vessels have water up to Perth in spring tides; while there is hardly water for the smallest class of decked vessels in neap tides. In their survey for the improvement of the navigation of the Forth between Stirling and Alloa, the Reporters found the fords on that river to be ridges of basaltic greenstone, which, of course, it would be difficult to remove; but on the Tay they have lately ascertained, by dredging and boring to the depth of 8 or 10 feet, that they consist of loose gravel, varying in size from small granulations to boulders as large as pigeons' eggs, a kind of obstruction, the removal of which would be comparatively easy. The first object, in the view of the Reporters, is to reduce these fords by dredging with the steam-barge apparatus, which is about to be launched for the use of the harbour trust. At the same time, they propose to shut up certain spill-water channels, by connecting Sleepless and Balhepburn islands with the right or southern bank of the river, and Darry island with the left bank, by means of embankments the positions of which are shown in red coloured lines on the plan.

Lower down the river, and immediately above and below the confluence of the Earn and the Tay, nine or ten large cairns of loose boulder stones, containing several tons each, have to the great detriment of the navigation, been heaped or built by the fishers for the purpose of hauling their nets. The disturbing action of these large heaps of stone distorts the current, and throws over upon the north side of Mugdrum island a great quantity of water, which would otherwise flow upon the southern side along with the main body of the united streams of the Tay and the Earn. By shutting up the spill-water channels at the three islands above mentioned and removing these cairns, the river will flow in a more connected and powerful stream, and will thereby tend to assist the dredging operations.

With the dredging machine, it is intended to excavate from 4 feet 3 inches to 4 feet 9 inches in depth from the fords, and thus to form a navigable track of a breadth varying from 80 to 100 yards. By this means it is expected that, in the course of two working seasons, the track from Newburgh to Perth will be deepened so as to admit the passage of merchant ships of the draft of 16 feet at spring tides and 11 feet at neap tides,—or of the burden of 380 and 130 tons. This is about the largest size of vessels which frequent the tide harbours of the eastern coast of Scotland. The expense of deepening the fords and embanking the channel, agreeably to the annexed estimate, amounts 5,500*l.* 14*s.* 3*d.* This sum includes 20 per cent. on the estimated price, to provide for the contingencies which may occur in this kind of work.

A question of much interest naturally occurs, regarding the means of preserving the proposed depth upon the fords when once obtained. It is not difficult to theorise on subjects of this kind, without coming to any definite result; but it is certain, that unless actual trial be made, no very satisfactory opinion can be given on this point. There are, however, many examples since the introduction of the steam dredging machine, of the advantage of its uses in connection with embanking rivers in order to confine their currents within certain limits; and the former inconveniences of a narrow track or fairway are now much less felt since the adoption of the steam-tug at most ports on the coast. In a river like the Tay, however, regard must always be paid to the free admission of the tidal waters, which four times a day pass over its bed, and the scouring action of which, together with the constant use of the dredging machine in some part of the river, will, it is expected, preserve the depth acquired. From an attentive consideration of the data obtained by their survey, the Reporters have every confidence in stating, that they consider it to be practicable to deepen the fords and preserve the channel over them by the means just described.

In connection with the improvement of the navigation over the fords, the Reporters propose the formation of a tide harbour before the wet dock is executed. By this means provision will be made for the berthage of vessels out of the stream of the river, an object which the Reporters have always considered of great importance to the trade of Perth. It will be seen from the plan, that this tide-harbour extends to an area of 2½ acres, which it is proposed to line with a breastwall or quay of squared masonry, extending to 286 yards upon its western side, and on the eastern side with a *revêtement* of rubble-pitching, having a *talus* or slope of one perpendicular to one horizontal. Into this tide harbour a tunnel of squared masonry is intended to issue for the outlet of Craigie Burn. The expense of excavating this tide harbour, and building its surrounding walls, is estimated at 9,168*l.* 18*s.*, which, with the deepening of the fords, and improvement of the navigation, make a total of 14,769*l.* 12*s.* 3*d.*, for improving the harbour to this extent.

But this design for the further improvement of the harbour of Perth is capable of great extension, by the formation of a wet dock on the South Inch. Accordingly, the plan upon an enlarged scale, marked No. 2, embraces plans and sections of an entrance lock, with a reach of canal leading into a wet dock of sufficient quay room for the berthage of 50 ships, of 100 tons, lying in two tiers. As the whole scale of the works proceeds upon the datum of obtaining 16 feet water on the fords, with an 8 feet tide at the new quay, the sill of the entrance lock is shown at a depth to suit these levels, as will appear from the sections. The width of the chamber of the lock does not exceed 36 feet 6 inches. It might perhaps be desirable to increase the width of the gates for the admission of large steam-boats; but as these vessels can be accommodated in the tide basin, it has been thought advisable to avoid the enlargement of the gates to a size which would be incommodious for the ordinary trade of the port. It further deserves consideration, that the continual improvements and alterations which take place in steam navigation, leave some room for hoping that this class of vessels may yet be rendered efficient upon a less cumbrous scale than that of any at present in use. On these grounds, an entrance lock of dimensions calculated to admit sailing vessels of about 380 tons, and drawing about 16 feet water, has been designed; and its expense is estimated at 10,343*l.* 18*s.* 8*d.*

Along with the lock, it is proposed to excavate a canal 132 feet in width, and 440 yards in length, which will lead into the wet dock. This reach of canal will also afford berthage for vessels; and is intended to be lined on both sides with walls of rubble-pitching, similar to that described for the east side of the tide harbour. The estimate for the canal amounts to 6,464*l.* 12*s.* 11*d.*

The execution of these works, which are meant to follow the deepening of the fords and the formation of the tide harbour, may be delayed till the year 1837.

The remaining work in the plan, is a wet dock of the area of five acres calculated for the berthage of 50 ships, of about 100 tons of burden, ranged in two tiers. The depth of the dock corresponds with the level of the sill of the lock: and its sides will be lined with squared masonry. The expense is estimated at 22,737*l.* 4*s.* 4*d.*; but it is not likely that the funds for this work will be required till the year 1840.

No. 125.
Stevenson, on improving the Navigation of the Tay between Perth and Newburgh, and making a Tide Harbour and Wet Dock at Perth; and Estimate.

It is impossible to imagine any situation better adapted for works such as have now been described than Perth. The order in which they can be executed admits of their being carried to such an extent only as to suit the revenue at the command of the commission; and yet every part is so independent of what may follow as to be complete in itself, so that the navigation will be gradually improved as the work advances. It is for this reason that the Reporters recommend the deepening of the fords and the formation of the tide harbour, as the works which first deserve attention, because their execution will provide Perth with a harbour complete in itself, though of moderate dimensions, and capable of being enlarged to any extent which the increased traffic of the port may require. In the present state of the river, deepening the fords and forming a tide harbour, such as that designed, are works of indispensable necessity, and the success which may attend these changes will indicate with certainty the propriety of proceeding with or delaying the construction of the wet dock. In point of fact, therefore, the commission may be said to enter upon an extensive scheme of operations, requiring an outlay of 54,314*l.* 18*s.* 2*d.*, with the least possible risk of failure, as every chance of ruinous expenditure in completing the full extent of work, is precluded by the method of procedure above proposed, which will prevent the ulterior works from becoming ineffective through the failure of what has gone before. The Reporters deem it unnecessary at this time to enter further into detail regarding the proposed system of operations. They therefore merely notice generally that, from the minute and careful survey of the river, which they have completed between Perth and Newburgh, and the data thus acquired for deepening the fords, as well as from the nature of the ground chosen for the site of the tide harbour and wet dock, together with the dredging and boring of the soil, which was executed for their information, they have no hesitation in pronouncing the works quite practicable. In doing so it affords them no small gratification to be able to state that their opinions are in accordance with the able advice of the late Mr. Rennie, originally given in 1803, and again repeated in 1807, when one of the Reporters accompanied him to Perth.

In reference to the operations partly executed under the Act of Parliament lately obtained for the improvement of the harbour of Perth, the Reporters beg to observe that the dilapidated state of the old quay walls would ere long have rendered it necessary to rebuild them, or at least to put them in such a state of repair as would enable the small vessels and boats which frequent the port to have free access to the shore. In accordance, however, with the advice already given regarding the construction of a tide harbour and wet dock, they do not consider it necessary to change the old line of quay for the sake of obtaining deeper water, nor to rebuild it in a style materially different from that of the original walls. In so far as the new quay has proceeded, it would be premature to adopt any resolution concerning its removal, until its effect upon the bed of the river shall have been more fully tried.

It now only remains briefly to advert to the funds which may be placed at the disposal of the new commission. Valuing the annual revenue from the shore dues at only 2,500*l.*, there would be enough at 4 per cent, to pay the interest of 62,500*l.* This sum affords ample security for the expenditure which will from time to time be necessary in carrying the improvement into effect; and the Reporters do not think it necessary to enter further into this subject, as, from the great experience of the framers of the proposed Bill for Parliament, perfect confidence may be placed in the accuracy of their information and their foresight in making the necessary provisions of the Act.

The Reporters conclude, by observing that there is no room to doubt that the improvement of the harbour will produce a correspondent increase of the funds which are derived from shore dues; and they beg to refer to the case of some harbours in the north upon a much smaller scale than that of Perth, with which they have been professionally connected. At Fraserburgh, in 1808, before the harbour was improved, and the new Act for regulating its schedule of dues was obtained, the shore dues were let at 45*l.* per annum; but since that period the revenue has gradually increased and in 1832 it amounted to 1,260*l.* The harbour dues of Peterhead in 1810 yielded 495*l.*, but in 1833 they amounted to 1,901*l.* In like manner Stonehaven, before its harbour was improved in 1826, had a revenue of from 40*l.* to 60*l.*; but in 1831 the shore dues had increased to 555*l.* 9*s.* 4*d.* The examples of recent increase of trade in situations so much less favourable than Perth, give ample reason to hope that the improvements proposed for the adoption of the Commissioners to be appointed by the intended Bill will have a beneficial influence upon the revenue which the burgh now derives from its shore dues.

ROBERT STEVENSON,
ALAN STEVENSON.

Abstract of Estimates of the Expense of Improving the Navigation of the Tay between Perth and Newburgh, and making a Tide Harbour and Wet Docks at Perth, agreeably to the foregoing Report, independently of Land Damage.

	£	*s.*	*d.*
Improvement of the Navigation . . .	5,600	14	3
Tide Harbour	9.168	18	0
Entrance Lock	10,343	8	8
Ship Canal	6,464	12	11
Wet Dock	22,737	4	4
Total	£54,314	18	2

No. 126.

No. 126.
Memorial of the Lord Provost, Magistrates, and Town Council of Perth, and Harbour Commissioners to the Admiralty.

Memorial of the Lord Provost, Magistrates, and Town Council of Perth, and the Commissioners under the Perth Navigation and Harbour Acts, to the Lords of the Admiralty,

SHEWETH,

THAT the memorialists have to solicit the serious attention of your lordships to a scheme which has lately been submitted to the public for making a line of railway from Burntisland to Dundee and Perth, one branch of which is intended to cross the river Tay by a bridge at Mugdrum, and the other to cross the river Earn by a bridge at a point near its junction with the Tay.

APPENDIX C.

PERTH.

No. 126.
Memorial of the Lord Provost, Magistrates, and Town Council of Perth, and the Harbour Commissioners to the Admiralty.

Your memorialists have not seen the plans of the proposed bridges; but they are satisfied that any attempt to cross these rivers at the points proposed—and particularly the attempt to throw a bridge across the Tay at any point between the harbour of Perth and the ocean—is a matter involving serious prejudice to the interests of navigation, and which therefore calls for the prompt interference of your Lordships.

It may be proper to explain to your Lordships, in the outset, that the memorialists, the magistrates of Perth, possess certain vested rights in regard to the navigation of the Tay, of which the projectors of the schemes already referred to do not seem to have been aware. They have the right of free port and harbour in the Tay, so far as it runs opposite to the sheriffdom of Perth (or, in other words, to within three miles from Dundee), and are conservators of the river within these bounds. These important privileges were conferred upon them in early times by the Kings of Scotland, and were confirmed by a Charter from King James VI., as well as by a subsequent decree-arbitral pronounced by the same monarch, both of which were ratified by an Act of the Scottish Parliament, July 9th, 1606. Accordingly, the magistrates of Perth have, for centuries past, exercised a constant superintendence and guardianship over the navigation of the river, and have, from time to time, successfully resisted the encroachments attempted to be made upon it by private parties.

Until within the last few years, however, the navigation of the Tay was very different from what it has since become, in consequence of the improvements to be afterwards noticed. Previously to 1830, the harbour of Perth was inaccessible to vessels of the larger class which now frequent it, while vessels drawing from 8 to 9 feet of water could make their way up to the quays of Perth only during spring tides, and with considerable difficulty even then. If, unfortunately, they missed the high tides, they became *neaped* in the river, and were obliged to remain until the following springs. The difficulty of the navigation was occasioned partly by certain fords or shallows, most of them of rather a formidable character, and partly by huge boulders scattered in the fairway, by coming in contact with which vessels were frequently subjected to serious damage. The state of the navigation previously to 1830 may be inferred from the fact, that the largest vessel which could by any possibility, and in the face of the then existing difficulties, approach the harbour fully laden, did not exceed 60 tons register.

In the course of the last-mentioned year, however, the memorialists set seriously about improving the navigation of the river. First of all, they obtained, in the session of 1830, "An Act for enlarging, improving, and maintaining the Port and Harbour of Perth, for improving the Navigation of the River Tay to the said City, and for other purposes therewith connected." This Act proceeds upon the preamble that "the navigation of the river Tay, from the city of Perth to its influx with the sea, is much *impeded and obstructed by fords or shallows* in many parts thereof, and *in particular* by a ford or shallow betwixt the quays or shores of Perth and the Friarton, known by the name of the *Weel Ford, whereby vessels cannot pass to and from the city of Perth unless in the time of flood or high water at spring tides.*" Commissioners were appointed to execute the purposes of the Act, and powers were taken to "cleanse, scour, cut, and deepen" the river within the limits above mentioned, "and to widen the same to such breadth as may be found expedient for enabling vessels resorting to the city and harbour of Perth to pass and repass with safety and facility; and also to repair, rebuild, extend, and enlarge the present quays, shores, piers, and landing-places of the said harbour, and the roads and accesses thereto," &c.; and to erect, make, and build new quays, &c., "reserving always to the proprietors of lands adjacent to the said river all rights competent to them by law, and satisfaction being always made to the owners and occupiers of the lands, tenements, fishings, and other heritages adjacent to or in the said river Tay, which may be injured or damaged by, or in consequence of, the said operations," and for whose indemnification the property and common good of the city of Perth were declared liable. For accomplishing the purposes above described, the commissioners were authorised to borrow and expend the sum of 16,000*l*.

Under this Statute various improvements of a minor character were effected, and a new quay was built at the harbour of Perth; but it soon became manifest, that, in order fully to realise the advantages anticipated from these operations, it would be necessary again to go to Parliament, and to ask for much more extensive powers than had been conferred by the Act of 1830. By the last-mentioned Statute, the operations of the commissioners, so far as related to the scouring and deepening of the river, were limited to that part of the river extending from the town's ford to the Friarton, a space of somewhat less than half a mile; but powers had not been taken to reduce the fords and shallows in the lower part of the river, some of which presented obstructions to the navigation nearly as great as the town's ford, while, in the opinion of many, it would be more judicious to avoid the town's ford altogether, by the construction of a tide harbour, canal, and docks. The memorialists being anxious to take such measures as should secure the important object in view, in the first place obtained a report from Messrs. Robert Stevenson and Son, civil engineers, who had bestowed much attention on the subject; and to that report, a copy of which is herewith transmitted, the memorialists have to solicit the attention of your Lordships, as shewing the state of the navigation at that time (February, 1834), as well as the nature of the improvements which were then contemplated, and have since been partly carried into effect.

Following up the recommendations of Messrs. Stevenson, the memorialists applied for and obtained a new Act in 1834, whereby (without reference to the powers competent to the magistrates, and under an express reservation of their rights) power was given to the harbour commissioners, in addition to the operations authorised by the previous Statute, to form a tide harbour, docks, and canals; "to cause, lessen, or remove in whole, or in part, by dredging by steam-vessels, hand labour, or otherwise, all banks, bars, fords, shallows, bursts, or other obstructions" to the free navigation of the river; to adopt every other means for improving the navigation by deepening or altering the channel, and connecting several islands in the Tay with the mainland. The time for executing the works was limited to five years from and after the passing of this Act, in so far as regards the operations for deepening and improving the navigation of the Tay, and to twenty years so far as regards the other works and operations; but by a supplementary Act obtained in 1839, a further period of two years was allowed for completing the river operations. Compensation was provided to the proprietors of salmon fishings for the damage that it was supposed must be occasioned to their interests by the operations authorised by the Act. The produce of each proprietor's fishings was to be ascertained by the average of the five years preceding 1834, and any shortcoming was to be paid over annually by the commissioners during the continuance of the operations, and for five years after they should cease, at which time the permanent damage to fishings should be ascertained, and the compensation paid over to the

Appendix C.

Perth

No. 126.]
Memorial of the Lord Provost, Magistrates, and Town Council of Perth, and the Harbour Commissioners to the Admiralty.

parties entitled to receive it, in capital sums. The commissioners, besides expending the surplus of the statutory rates and duties, were authorised to borrow money for the purposes of both Acts to the extent of 50,000*l.*, for which the magistrates and town council were authorised to interpose the security of the city of Perth. The provisions of the Statute of 1830, as to the liability of the property of the city for the indemnification of parties entitled to damage, were repeated. And the commissioners were prohibited from proceeding further with the operations authorised, than the deepening of the river, and the formation of the tide harbour, or from expending or borrowing more than a limited sum for these purposes, until compensation should be made or provided for to the proprietors of salmon fishings.

Immediately after the passing of this Act, the harbour commissioners commenced their operations, and in the course of the last ten years much has been done for the improvement of the navigation. The principal fords, and many intermediate shallows not shown in the sections, have been removed, together with many detached boulders of immense size. The river, along its course from Perth to Newburgh, has been dredged and deepened. The islands of Sleepless, Darry, and Balhepburn have been connected with the mainland by embankments formed of the produce of the dredging, so as to confine the whole of the water in the navigable channel, and render the scour more effective. The banks of the river in many places, where much contracted, have been excavated and removed, in order to equalise the currents, by allowing sufficient space for the free passage of the water. A tide harbour (the first part of the plan for establishing docks at Perth) has been formed, and a road from the town to communicate with it, which is now in constant use. The situation and object of this work, and the relation which it bears to the more extended design, will be seen by examining plan No. 2, appended to Messrs. Stevenson's report; and it may be here mentioned, that the whole of the extended work was actually contracted for, and would ere now have been completed, but for the opposition of certain proprietors of fishings, who objected to the canal and docks being proceeded with until compensation should be made or provided, in terms of the Act. All these improvements have been effected at an expense of not less than 53,000*l.*, in addition to the indemnification to the proprietors of fishings, which has already been awarded to the extent of 6,000*l.*, while the final compensation payable to them, which cannot be ascertained for two or three years to come, must amount to many thousands more. But it is not to be understood that the operations authorised by the Act have yet reached their limit. The river is susceptible of still greater improvements, and these will be carried on from time to time, as the trading interests of Perth may require, unless a stop be put to them by the interference with navigation contemplated by the railway projectors.

The advantages that have already resulted from the works carried on by the harbour commissioners are neither few nor small. By affording a clearer and freer passage for the tidal currents, the tide now begins to flow at Perth fully half an hour sooner than before, while the time of high water remains nearly the same; and thus the advantages of increased depth, due to the presence of the tide, are proportionally increased throughout the whole range of the navigation. The depths in the *shallowest* parts of the river are now pretty nearly equal, being 5 *feet* at low and 15 *feet* at high water of *ordinary spring tides*. Steamers of small draft can now ply regularly at low water while, at ordinary spring tides *vessels drawing* 14 *feet of water* can come up to Perth, *in one tide*, with ease and safety. In the year 1833, the registered tonnage of vessels belonging to the port of Perth was 5,149, the number of vessels of 100 tons and upwards being only 12, and the largest vessel 144 tons. In 1844, the tonnage has increased to 7,797, including 22 vessels from 100 to 150 tons, 7 from 150 to 200, 6 from 200 to 300, and 2 above 400 tons register. Many large vessels from foreign ports are also in the practice of frequenting the harbour; and so great has the traffic become, that sometimes no fewer than 15 vessels, all under sail, now arrive at the shore in one tide. The shore dues leviable at the port have increased in the same proportion. The Customs, which, before the commencement of the statutory operations, produced only 2,969*l.*, have, on an average of the last five years, produced the sum of 16,837*l.*, and were in one year so high as 25,767*l.* Many other facts might be brought forward to shew the beneficial effects resulting from the improvement of the river; but the memorialists have no doubt that those just stated will be considered amply sufficient.

It is in this state of matters, and after so much has been done, at so great an expenditure of money, to make this fine river fully available for the purposes of navigation, that the project has been seriously brought forward of throwing a bridge across the Tay at Mugdrum. The memorialists feel satisfied that the bare mention of such a proposition must create surprise in the minds of your Lordships, that any party could be found willing to flatter themselves with the belief that so wild a scheme should ever find countenance from the guardians of the navigation of the country; and the more the nature and inevitable consequences of the scheme are considered, the more will they appear to your Lordships to be fraught with perils of no ordinary kind.

It is quite necessary to keep in view that the river Tay is somewhat peculiar. Receiving the drainage water from the most elevated parts of the country, of a portion of Scotland extending to 2,283 square miles, its volume is subject to sudden and extensive fluctuations, depending on the state of the weather, or melting of the snow or ice in the highland districts. Its mean discharge at Mugdrum has been ascertained to be upwards of 250,000 cubic feet per minute. The natural tendency of the river, as your Lordships may readily suppose, is to throw up shallows and sandbanks all along its navigable course, and in no part of it is this tendency so great or so observable as *at*, and *immediately below, Mugdrum.*

These considerations must satisfy your Lordships that it is absolutely impossible to construct a bridge, of any description whatever, at Mugdrum, that will not have the effect, by the interruption which it will offer to the current, of disturbing and distorting the channel, and throwing up sandbanks at the bridge, as well as above and below it. It was only last year that the magistrates of Perth succeeded, after a tedious and expensive litigation, in obtaining a judgment for the removal of certain jetties which had been thrown out by the Earl of Zetland on the shores of the Tay at and below Newburgh, and which, by the evidence on the trial, were demonstrated to be prejudicial in the way just mentioned. Now, if such was the effect of jetties only protruding into the river a short way from the shore, what is to be expected as the natural result of an interruption extending across nearly the whole breadth of the river? The memorialists understand it is proposed to leave a space of sixty feet, or thereby, open for the passage of vessels through the bridge; but every one who knows the nature of the river at that spot, and its agitated state in wintry and tempestuous weather, must at once perceive that such a scheme is just tantamount to shutting up the navigable channel altogether. There are certain states of the weather and tides which would not admit of vessels readily taking the

APPENDIX C.

PERTH.

No. 126.
Memorial of the Lord Provost, Magistrates, and Town Council of Perth and the Harbour Commissioners to the Admiralty.

passage, while there is no room to allow them to *beat*. It may frequently happen, too, that the very time when the bridge happens to be shut, is just the critical moment at which a vessel ought to pass on her voyage up or down the river. The inevitable result will be, that mariners will shun a navigation liable to such interruptions, and in this way the memorialists will not only be deprived of the security which the rates and duties of an open river would afford, to indemnify them for their obligations, but the trade of the city which they represent would gradually decline.

Nor is it only with reference to the interests of navigation that a bridge at Mugdrum would be liable to serious objection. Your Lordships are no doubt aware, that in a severe winter the breaking up of a storm is attended with great and imminent peril on the banks of the Tay. History records many instances of disaster from this cause. The city of Perth is subject to inundations, greater or less in degree, almost every second or third winter. On one occasion, at a remote period, the town was swept away altogether. In later times, two bridges have successively shared the same fate, and the present bridge, though a fabric of great strength, has often been in extreme danger. Even the wide span of its arches does not afford a sufficient passage for the large masses of ice which come floating down the stream, and any interruption arising in that quarter causes the diversion of the river from its bed, and throws the whole volume of its waters over the North Inch and town of Perth. In averting a calamity of this sort, everything depends upon keeping the river open below, so as to afford a clear passage for the ice after it gets through the bridge, for if it gets gorged at any point further down, the intermediate space between it and the bridge is immediately filled up, and in such a state of matters the destruction of the city would be inevitable. The serious consequences that resulted from the breaking up of the storms in 1793 and 1814, shew that this is no causeless apprehension. Now, the memorialists may well ask your Lordships, what would be the probable, or rather the certain, consequence of placing an additional barrier across the river at Mugdrum, which it is important to remark, is the very place where the flowing and receding tides meet, and where, in consequence, the river is frequently blocked up with ice, while there is little ice at any other part of its course? Why, just this, that besides the accumulation of banks and fords, which of themselves serve in no small degree to arrest the passage of the ice, there would be no possibility of the ice getting through the bridge; and the space between Mugdrum and Perth being speedily choked up, not only the town, but great part of the country along the course of the Tay, would be laid under water. This consideration too, only acquires additional force from the fact, that it is part of the scheme of the railway projectors to shut up the north channel of the river altogether, by which the whole waters of the Tay, and the whole of the datached masses of ice borne along by its winter currents, would be directed against the narrow gorge at Mugdrum, and in vain seek an outlet through the passage of sixty feet proposed to be left for the purposes of navigation and the protection of the public. Indeed, there are not a few who entertain the opinion that any bridge placed in this situation would not survive the trials of an ordinarily severe winter.

Lastly, there is every reason to apprehend that the construction of a bridge at Mugdrum would be prejudicial to the interest of the salmon fishings in the river above that point. Not only do the magistrates and town-council of Perth stand in the peculiar situation already explained, being bound by Statute for the indemnification of parties entitled to damages under the Perth Harbour and Navigation Acts; they are themselves proprietors of salmon fishings of great value between Mugdrum and Perth, and derive a large part of their revenue from this source. On both grounds, therefore, they would feel called on to remonstrate against the injurious consequences of the proposed measure, for it is surely sufficiently obvious, that if the stake-net system, the illegality of which has long ago been declared, was attended with injurious consequences to the upper heritor of fishings, any bridge fit to stand against the force of the current for a single day at Mugdrum, must be infinitely more so.

The memorialists have to apologise to your Lordships for troubling you at so much length on this very important subject. They trust, however, that the unprecedented nature of the invasion proposed will be admitted as a sufficient apology. They are anxious to place the matter before your Lordships in its proper light, and to show you that the promoters of the bridge cannot succeed in their object without encroaching upon the vested rights of the memorialists, destroying the navigation of one of the most important rivers in the kingdom, and inflicting grievous injury as well upon the public as upon private parties. If it be said that the trade of Perth is comparatively small, the memorialists refer to the marked increase that has taken place within the last few years, and to the prospective benefits in which they as well as others are likely to participate from the further improvement of the Tay and harbour at Perth. If again, the importance of railway communication through particular districts be urged, the memorialists answer, that there is abundant room for railway speculation without trenching upon either seas or rivers, which are the highways of the world. They cannot allow themselves to suppose that Parliament will ever lend its sanction to so unwarrantable an encroachment; but they confidently trust that the timely interference of your Lordships will at once put an end to the scheme, and save them from the trouble and expense of a parliamentary contest, to which they might otherwise be exposed.

C. G. SIDEY, *Lord Provost of Perth.*

Perth, October 3, 1844.

No. 127.
Stevenson, on the Tay, and proposed Railway Bridge over the River near Mugdrum.

No. 127.

Messrs. STEVENSON and SON'S *Report on the Tay, and proposed Railway Bridge over the River near Mugdrum.*

Edinburgh, January 7, 1845.

ON the 18th, 19th, and 20th September last, we had various meetings with Mr. Rendel, civil engineer, who has been appointed by the Admiralty to report on the bridges proposed to be erected over the rivers Tay and Earn, by the promoters of the projected Edinburgh and Northern, and Dundee and Perth Railways; and on the 19th, Mr. David Stevenson, accompanied Mr. Rendel, Mr. Miller, the engineer for the railway, and Mr. Sheil, the solicitor, in an examination of these rivers, in the vicinity of the proposed points of crossing. Since that time we have again visited the place, and, at the request of the magistrates, we have made certain observations on the depths of water, strength and direction of currents, borings, &c., for the information of Mr. Rendel; and we have also been considering the proposed scheme of crossing these rivers, in order that we may report our opinion as to

APPENDIX C.

PERTH.

No. 127.

Stevenson, on the Tay, and proposed Railway Bridge over the River, near Mugdrum.

the effect likely to be produced on the Tay navigation by the proposed operations of the railway company. Before proceeding, however, to enter upon this question, we shall, as requested by Mr. Rendel, in his letter of the 19th instant, to Messrs. Mackenzie and Reid, the city clerks, offer a few remarks "on the past and present state of the navigation," as a proper introduction to what is more immediately the subject of the report.

The river Tay, with its numerous tributaries, receives the drainage water of a district of Scotland which as measured accurately on Arrowsmith's map, extends to 2283 square miles. Some of the most elevated land in the country is included in this space, and the volume of the river is consequently subject to sudden and great fluctuations, depending on the state of the weather, or the melting of the snow in the highland districts. This liability to fluctuation in the amount of its discharge is greatly aggravated by the effect of the westerly gales on Loch Tay, whence the river issues. These gales, acting on the lake, raise the level of its surface at its eastern end, and the water pours into the river in large quantity, often causing unexpected freshes, independently of rain or sudden thaws. The mean discharge of the river at Perth, as determined by Professor Anderson of St. Andrew's, from accurate measurement made for a judicial purpose, is 218,158 cubic feet per minute; and if that of Earn, which we have lately ascertained to be 54,959 cubic feet, be added, the whole *mean* discharge of the Tay at Mugdrum island, exclusive of the drainage of the valley between Perth and that place, is 273,117 cubic feet per minute. Judging from the extent of drainage, as compared with any other river in Scotland, and it is believed in Britain, the Tay appears to be much the largest. The Clyde, for example, drains 945 square miles; the Spey, 1234; the Tweed, 1687; the Forth, 793; the Cromarty Firth, 633; the Dornoch Firth, 589; while the drainage of the Tay, as already stated, is 2283 miles.*

The river is, at present, navigable as far as Perth, which is 22 miles from Dundee, and 32 from the German Ocean. At that place it is crossed by the bridge of Perth, the waterway of which is 575 feet.

The influence of the tide extends to the junction of the Tay and the Almond, which is 2⅓ miles above Perth, and 34⅓ miles from the Gaa Sands, at the entrance to the Firth of Tay. At Dundee, which is 10 miles from the Gaa Sands, the rise of tide, from lowest neaps to highest springs, ranges from 7 to 18 feet. At Newburgh, 13 miles from Dundee, and 9 miles from Perth, the range of tide is from 6 feet 6 inches to 15 feet. At Perth, the rise of tide is from 6 to 13 feet. The fall on the surface of low water from Perth to Newburgh is 2 feet, or about 2¾ inches per mile; and from Newburgh to Balmbreich, at low water, 3 feet in springs, or about 10½ inches per mile, and 1 foot 3 inches in neaps. On high water, the fall from Perth to Newburgh is 1 foot 6 inches in springs, and 1 foot in neaps; and from Newburgh to Flisk the fall is 5½ inches in springs, and the same in neaps. The time of high water at full and change at Dundee is 2h. 30m.; at Newburgh, 3h. 15m.; and at Perth, 3h. 55m.

The depth of water throughout the Firth ranges from 6 to 9 fathoms at high water; and there is said to be 16 feet at low water on the bar at the Gaa Sands. The depth from the point where the conservatorship of the city of Perth commences, at Invergowrie Bay to Flisk Point, is about 30 feet at high water in ordinary springs. Between Flisk Point and Newburgh it gradually decreases from 30 feet to 18 feet; and from Newburgh to Perth from 18 to 15 feet. Throughout the whole course of the river the breadth may be said to be ample, the narrowest part, before reaching Friarton (which is near the entrance to the tide harbour of Perth) being at Kinfauns, where the navigable breadth, of 15 feet at high water, measures, at one point, 220 feet; but this is a solitary exception from the general breadth of 100 yards.

Although Smeaton, Rennie, and other engineers of eminence, had from time to time been consulted, no vigorous steps had been taken towards improving the navigation of the Tay previous to the year 1834, owing chiefly to the fear that existed among the landed proprietors of deteriorating the value of the salmon fishings by any extensive engineering operations of the river.

During the session of 1834 however, an Act of Parliament was obtained, not only for improving the navigation, but for constructing a tide harbour, entrance lock, ship canal, and wet docks, at Perth, as recommended by us in a report of the 22nd January, 1834 By that Act, a period of five years only was allowed for the deepening of the river; and, at the expiry of that time, although the depth then gained was, if necessary, to be maintained by occasional dredging, no new improvements were to be undertaken for a like period of five years, in order to ascertain if any, and what amount of compensation would be payable to the proprietors of the fishings for damage done by these operations. The time allowed for the execution of this department of the works, however, was found to be too limited, as a considerable period had elapsed after the passing of the Act before final arrangements could be made with the various proprietors so as to permit the works to be vigorously commenced; and in the session of 1839, in consequence of a representation of the great improvements that had already been effected a supplementary Act was obtained prolonging the period of working for other two years, and this additional grant expired in 1841, since which time no additional works have been undertaken, the attention of the commission having been confined to maintaining the embankments of the river, and otherwise keeping the navigation in a proper state of repair.

The whole period, then, over which the operations of the commission have extended embraces six working seasons; and we would now briefly advert to the state of the river previous to the commencement of the improvements, the several works that have been executed, and the beneficial effect which they have produced.

Before the commencement of the works, the magistrates and council are aware that certain ridges, called "Fords," stretched across the bed of the river at different points between Perth and Newburgh. These fords, as explained in a former report, the substance of which we cannot do better than quote in this place, were found to obstruct the navigation to such a degree, that loaded vessels of ordinary tonnage, drawing from 10 to 11 feet of water, could not make their way up to the quays of Perth, excepting in spring tides, and even then not without great difficulty; while vessels missing the few days of high tides lost a fortnight in waiting for the following springs. In this way the freight of ships to Perth was greatly enhanced, as a moderate rate would not cover such casualties; and mariners were therefore induced as much as possible to avoid the port, both on account of the uncertainty of their time, and the damage which their vessels often received in the passage up and down the river.

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* The discharge of the Thames at Teddington weir is 80,220 cubic feet per minute, or less than one-third of that of the Tay.—*Report of the British Association on Hydraulics, by George Rennie, Esq., F.R.S.*

Appendix C.

Perth.

No. 127.
Stevenson, on the Tay, and proposed Railway Bridge over the River, near Mugdrum.

But the trouble and delay in the navigation were not the only objections which attended the port of Perth. There was no provision for the safety of vessels after they had reached their moorings; and, from want of proper accommodation, they lay in the stream, exposed to the rapid winter currents of the Tay, and to danger from the breaking up of ice in floods. They were not only in danger of breaking adrift, but of being laid *high and dry* upon the roadway of the quay, accidents which not unfrequently happened. Under all these disadvantages, Perth was anything but a desirable port for the mariner; and, though a few coasters who made the town their home continued to frequent it, it was not a very general resort of foreign or even coasting vessels. The merchants were thus either cramped in their traffic, or obliged to form connections at places below the fords, from whence their goods were chiefly shipped in lighters, a method of conveyance which was very disadvantageous, from its uncertainty and the continual disappointment and extra expense which attended it; and while the neighbouring ports carried on a prosperous trade in a narrow and comparatively unimportant district, the port of Perth, under many advantages of position as the natural outlet to the highland districts, languished from want of a commodious harbour and an unobstructed communication with the sea.

The state of the navigation at the period referred to, will be best seen from the plan and section accompanying the printed report of 1834.

The depth of water on the fords, the most objectionable of which were six in number, varied from 1 foot 9 inches to 2 feet 6 inches at low, and from 11 feet 9 inches to 14 feet at high water of spring tides; and in addition to the shoalness of the water, many detached boulder stones, some of them between 40 and 50 tons weight, lay scattered over the bottom. Numerous fishing cairns had also been erected without regard to any object but the special one in which the proprietors of the land were interested; and in many cases they formed very prominent and dangerous obstructions to vessels.

The works, then, in which the harbour commission have been engaged for the purpose of remedying the evils alluded to, may be briefly described as follows:—

1st. The fords and many intermediate shallows not shown in sections accompanying the report of 1834, were deepened by steam-dredging; and the system of harrowing, which was so successfully practised on the Mersey, was employed on some of the softer banks in the lower part of the river.

2nd. The large detached boulders and fishing-cairns which obstructed the passage of vessels were removed, and this was effected chiefly by means of lighters mounted with powerful cranes, and the floatation by pontoons.

3rd. Three subsidiary channels at Sleepless, Darry, and Balhephurn islands, were shut up by means of embankments formed of the produce of the dredging, so as to confine the whole of the water to the navigable channel. These islands had hitherto operated disadvantageously, by dividing the currents into two branches, and thus rendering the scour less effective for the purposes of the navigation.

4th. In some places, the banks on each side of the river beyond low-water mark, where much contracted, were excavated and removed, in order to equalise the currents, by allowing sufficient space for the free passage of the water; and this was more especially done on the shores opposite Sleepless and Darry islands, where the shutting of the secondary channels required some compensating measure of this nature.

5th. A great part of the dredged material was deposited along the banks of the river in a careful manner, so as to improve and form new fishing beaches, to compensate, in as far as could be done, for the removal of the fishing cairns formerly in use, and for the effects of other hindrances to the free use of the fishing stations which the prosecution of the works in some instances unavoidably occasioned.

In addition to these various operations, which were more immediately connected with the improvement of the access to the port from the sea, the commissioners farther directed their attention to the desirable object of increasing the accommodation for vessels at Perth. For this purpose they considerably extended the quay room; and in order that vessels might be enabled to lie with greater safety, and be protected from the heavy floods and ice which come down the river during winter, and sometimes occasion great damage, they commenced the first part of the design for establishing docks at Perth, by forming a tide harbour, in which vessels lie always afloat, and a new road communicating with it from the town. These works have now been for some time completed, and in constant use; their situation and object, and the relation which they bear to the extended design, will be seen by examining plan No. 2, appended to the report of 1834; and it is perhaps sufficient in this place to say, that the whole of the extended work was actually contracted for, and would, in all probability, have been completed before this time, but for the intervention of a law plea, still pending between the harbour commission and one of the adjoining proprietors, in relation to the powers granted by the Act of Parliament.

Such was the state of the works when the parliamentary restrictions rendered it necessary for the Commission to suspend operations, which they did in January, 1842; and we have now to notice the improvement effected by their execution. The benefit to the navigation has been of a twofold kind; for not only has the depth of water been materially increased by actual deepening of the waterway, and the removal of numerous detached obstructions from the bed of the river; but, by a clearer and freer passage for the tidal currents having been afforded, the tide now begins to flow at Perth fully *fifty minutes* sooner than before, while the time of high water remains nearly the same; and thus the advantages of increased depth, due to the presence of the tide, are proportionally increased throughout the whole range of the navigation.

The depths in the shallowest parts of the river are now pretty nearly equalised, being 5 feet at low, and 15 feet at high water of ordinary spring tides. Steamers of small draft can now, therefore, ply regularly at low water; and one has for some time been so employed between Newburgh and Perth; while at ordinary springs, vessels drawing 14 feet of water can come up to Perth, in one tide, with ease and safety. In the completion of these improvements the harbour commission have expended upwards of 53,000*l.*; and, as shewn by the journals kept of the work, about 841,480 tons of material have been raised from the bed of the river by steam-dredging.

These increased facilities, as might naturally have been expected, have produced a very considerable increase on the trade of Perth. In 1833 the registered tonnage of vessels belonging to the port of Perth is stated to have been 5403, the number of vessels of 100 tons and upwards being twelve, and the largest vessel which frequented the port 144 tons. In 1844 the tonnage was increased to 8646, including twenty-two vessels from 100 to 150 tons, seven from 150 to 200, six from 200 to 300, and two above 400 tons register. Many large vessels from foreign ports are also in the practice

No. 127.
Stevenson, on Tay, and proposed Railway Bridge over the River, near Mugdrum.

of resorting to the harbour, instead of unloading, as formerly, at Newburgh; and are, in many instances, enabled to reach Perth in one tide from the German Ocean; and so great has the traffic become, that sometimes no fewer than fifteen vessels, all under sail, now arrive at the shore at once. Three steamers are also engaged in towing vessels; and one plies daily between Perth and Newburgh with goods and passengers. During the summer months, two steamers pass daily between Dundee and Perth; and one throughout the whole year between these places. The Customs, which before the commencement of the statutory operations, produced only 2969*l.*, have on an average of the last five years, produced the sum of 16,837*l.*, and were, in one year, so high as 25,767*l.*

Having given this brief notice of the present state of the navigation and trade, we now come to consider the probable effect of the proposed bridge across the Tay.

But before we enter directly on this subject, it may be proper to state, that the plans of the proposed erection have not been submitted to us, and that the only information we possess on the subject, independently of that afforded by the parliamentary plans, was given by Mr. Miller, the engineer for the railway company, on the occasion, already referred to, of our meeting with Mr. Rendel and him, when it was stated that the bridge was to consist entirely of pile-work, and that a draw or opening was to be provided in it of 60 feet in breadth, for the passage of the vessels navigating the river. From the parliamentary plans, we further find, that the bridge is to cross at a point about half way between the upper end of Mugdrum island and the mouth of the Earn, and that the level of the rails, when referred to our tidal observations, is to be 21 feet above high, and 32 feet 9 inches above low water.

After giving the subject due consideration, and completing a minute survey of the locality, comprising sections, soundings, and borings, and ascertaining the velocities and directions of currents, we are of opinion that the proposed erection will be prejudicial to the interests of the navigation in a three fold manner. 1st, As being, at all times, an inconvenience and obstruction to the passage of shipping. 2ndly, As tending to alter the channels, and produce shoals on the bed of the river. And, 3rdly, As aggravating, to a great extent, the stoppage of the navigation during winter, by the accumulation of ice. To these different objections we shall allude in detail.

Before the commencement of the improvements on the navigation, the shipping experienced great delay and difficulty in navigating that part of the river between Mugdrum Wood and the Earn which is represented on the plan accompanying this report, and across which it is now proposed to throw the bridge. This difficulty was occasioned partly by the shallowness of the water on Kirwingle ford, and partly by the narrowness and crookedness of the channel, where it was injuriously affected by the junction of the Earn and the division of the stream at Mugdrum island. The first of these evils was removed by dredging to the depths shown in dotted lines on the longitudinal section on the plan, which represents the former and present bed of the river; and the ford was, for this purpose, deepened, at some places, as will be seen by examining the section, as much as 5 *feet*. The second evil was, in a great measure, overcome by cutting away a considerable portion of the projection formed by the Carpow Bank, from one point of which, opposite Carpow jetty, an extent of material measuring 400 feet wide was removed; so that what was formerly dry at that place at low water, has now a depth of 7 feet, and is part of the navigable channel, which has thereby been greatly improved both in direction and width. These important improvements in that part of the navigation were effected at an expenditure exceeding 5,000*l.*; and the consequence is, that there is now a clear unobstructed navigable channel throughout the whole stretch of the river, from Cairnie to Newburgh, at no point less than 100 yards in breadth, and generally 150, and having throughout its whole area a depth of not less than 15 feet at high water of ordinary spring tides. This channel is shown in dark colour on the plan.* It affords good scope for vessels beating up and down the river; and, with leading winds, they can now steer a straight course from Mugdrum Wood to Cairnie pier. The chief disadvantage experienced in the former unimproved state of the navigation, was the liability that existed of vessels being *detained* by *grounding*, or being otherwise obstructed at these defective places, so as to lose the tide for Perth, which, at those times when the tides were falling from springs to neaps, often led to the necessity either of lightening the vessel or of detaining her till the succeeding springs should afford sufficient depth for passing the fords. The great object aimed at in the improvements, therefore, and especially in that at Carpow, was to remove every cause of *detention*, especially at this low part of the river, so that vessels might take the first of the flood to enable them to reach Perth during one tide. Nor was it a less important end to remove every obstacle which might prevent outward-bound vessels from reaching Newburgh, and the more open and deep parts of the navigation, with the same tide by which they were enabled to leave Perth. Neither of these objects could, it is obvious, be attained when vessels required the top of springs to carry them over the shallows near Perth, without providing at the lower fords a channel sufficiently deep and straight to be accessible, for some time *before* and *after* high water, to vessels inward and outward bound. That object may now be considered as completely attained by the works of the commissioners; and the proposal to erect a drawbridge across the place which was the scene of much of their labour, is a change so detrimental to freedom of passage on the Tay, and so diametrically opposed to all the principles that have guided the improvements on the navigation, that it is naturally regarded with alarm by the conservators, and undoubtedly involves many serious considerations which ought to be fully weighed.

Should this measure ever be carried into execution, the first obvious result that presents itself is that the railway company must have the full control of the opening of the bridge for the passage of vessels; and that the regulation of the navigation must virtually depend on officers appointed by them. For some time before the arrival of each train the navigation must be closed; and should the train happen to be detained, the traffic of the Tay must wait. On any line of communication, the interposition of a barrier for an indefinite length of time could not fail to prove an inconvenience; but, in the case of the Tay, such an evil will be greatly aggravated, from its being a tide navigation, in which the passage of vessels is restricted to a short period during every twelve hours, subject to daily variation in its recurrence with the time of high water. It may, therefore, often happen, and, of necessity, will sometimes happen, that the bridge will be closed at the very time when the vessels arrive with the ebbing or flowing tide; and thus their progress will be arrested for a greater or less period of time, according to the detention of the train, and the difficulty of *bringing the vessels to*, in a rapid stream, and again getting them under weigh when the draw is opened. In this way, the most

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*The extent and exact position of this space were ascertained by transverse lines of sounding, taken at intervals of about 100 yards apart throughout the whole extent of the river from Newburgh to Cairnie. These soundings it was considered unnecessary to introduce on the engraved plan. The longitudinal line of soundings on the plan are the depths in the middle of the navigable fairway.

APPENDIX C.

PERTH.

No. 127.
Stevenson, on the Tay, and proposed Railway Bridge over the River, near Mugdrum.

valuable results of the improvements undertaken by the commissioners, for the purpose of facilitating the passage of vessels, and making them less dependent on the tides, will be almost entirely nullified.

But we must say a few more words regarding a prominent inconvenience, to which we have merely alluded, as arising from the difficulty of bringing up vessels in time to wait the opening of the bridge.

The flood tide, on ordinary occasions, runs at the rate of from 2 to 2½ miles an hour, and the ebb about the same rate; and when there is any fresh in the river, the ebb runs considerably faster.* Even in the present improved state of the channel, vessels have been sometimes carried by the force of the current of ebb past the south Mugdrum channel, and down the north channel, which is not navigable; and there, after grounding, they have been forced to lie till the return of flood enabled them to work their way back to the main channel.

Under these circumstances, we cannot see how the frequent occurrence of accident is to be avoided, in attempting to *make* for an opening or gateway 60 feet wide, formed in the middle of a river, measuring 290 yards in breadth, at low, and 1040 yards, at high water, and with tides ordinarily running at the rate of from 2 to 2½ miles an hour, even with all the advantages which the use of steam-tugs affords; but this is a question which will, doubtless, be more properly referred to the opinion of nautical men. Certain it is, that the passage of vessels by night (at which time, at present, they beat up and down the river with nearly the same ease as during the day) will, under such disadvantages, be rendered almost wholly impracticable. And if the difficulty which we apprehend have any real existence, it must follow, that, independently of the mere delay occasioned by the closing of the bridge, damage and detention may often be expected from vessels getting embayed on either side of the opening, and running foul of the structure.

But, independently of the mere obstruction which the bridge itself will present to shipping, and which is alone sufficient to render it quite incompatible with the prosperity of the navigation, we have, in the next place, to consider the effects likely to be subsequently produced by it on the channel and bed of the river. The bed of the Tay, with the exception of certain hard ridges, which cross it nearly at right angles, is generally (at least within the range of the conservative power of the city of Perth) soft, and easily disturbed by any projection from the banks into the current. It was, on this ground, that the jetties, erected by the Earl of Zetland, below Newburgh, were complained of, and finally, at the instance of the conservators, were removed in obedience to an order of the Court of Session. Nor is it to the lower part of the river alone that such observations apply, as the changes wrought in the channel, at various parts of the river, in the course even of a few tides, by the action of the current sweeping past a stranded vessel, must be familiar to all who are acquainted with the Tay, and have often come under our notice in the course of professional surveys of its shores. Upon a knowledge of these facts, the commissioners of Perth harbour have thought it right, in the course of their jurisdiction, most strenuously and impartially to resist every attempt on the part of the proprietors to project landing piers, jetties, or fishing cairns, from their lands; and, from a decided conviction of the injurious tendency of every artificial projection into the stream, they have, in several instances, caused existing works to be removed, as well as prevented the erection of new ones For instances of their exertion of this power, we would more especially allude to the cases of Lord Gray's pier, the Earl of Wemyss's jetty at Muirhead, and the intended extension of Carpow Dyke. The bottom of the river, at the place proposed for crossing, is of the same soft nature. Beneath a coating of light gravel, mixed with sand, nothing is found, even at the depth of 18 feet below the bottom, but a quicksand, composed of very minute particles of mica and quartz. From these circumstances, and from our previous knowledge of the river, we have no hesitation in affirming, that it is impossible for any engineer to predict the changes in the channel that may from time to time be produced, by the varying action of the current, thus altered in direction, and increased in force, by storms, high tides, and floods, or even by the accumulation of ice piled by winter floods against the frame-work of the bridge. Thus, although the draw may at first be placed in the deepest part of the river, the channel will still, as it has already done, occasionally change with the altered circumstances of the currents which must necessarily follow so extensive a change as that which is projected; and, in this way, it seems almost probable that the navigable track must alter its position, and the opening for the passage of vessels may soon, and without previous warning, be situated in a permanent shallow. Such a result must effectually close the navigation.

The effect of the bridge, in preventing the passage of ice during the breaking up of frost, is another subject worthy of consideration; and the best information regarding it will be obtained from those who have been long acquainted with the river, and have had repeated opportunities of witnessing the accumulation of ice which takes place even at the bridge of Perth. It is well known that a year seldom elapses without a stoppage in the navigation taking place. Such suspensions of the traffic generally last for a period varying from a few days to a fortnight, and sometimes to a month, and they extend from Newburgh for some distance up the river. Large masses of ice, which are carried to and fro by the tidal currents, and continue to collect in considerable quantities, are the causes of these stoppages of the traffic. It is evident that a bridge on piles, extending across the river, would greatly retard the passage of the ice, and thus increase the inconvenience which, even now, is sometimes felt by shipping at this part of the river.

But besides these objections to the proposed scheme, as prejudicially affecting the navigation, various questions occur, involving other interests, none of which, in an inquiry like the present, ought to be overlooked. One of these is the effect of the proposed work on the salmon fisheries.† So great was the opposition offered by the proprietors of the fishings, as already noticed, that, before the Navigation Bill could be obtained, certain clauses were introduced, regulating the mode of carrying on the operations, and binding the Perth harbour commissioners to pay all damage, temporary or permanent, sustained by the fishers. Among other arrangements for the purpose of ascertaining the amount of this damage, a period of five years was named, during which the works were to cease, and the number of fish taken to be ascertained, in order that an average might be struck, and compared with that of five years previous to the commencement of the works. Two years of the five have still to run for ascertaining this average, which, if the bridge operations were begun, could not be completed. It will also be matter of consideration for the proprietors of fishings, whether or not,

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* The velocities and directions of the currents were ascertained by mooring buoys at intervals of about 800 feet apart, in the wake of a float. The positions of these buoys were determined by sextant observations, after the float had run its course, and the velocities by noting the elapsed times between the mooring of each buoy. These velocities were checked by numerous observations made with the tachometer.

† The total annual rental of the salmon fisheries of the Tay may be stated at between 10,000*l.* and 11,000*l.*

APPENDIX C.

PERTH.

No. 127.
Stevenson, on the Tay, and proposed Railway Bridge over the River, near Mugdrum.

independently altogether of the operations of the harbour commissioners, the effect of the proposed barrier will be to deteriorate the future value of the fishings. That some of those in the vicinity will be completely extinguished seems extremely probable. Another question which arises out of the proposed scheme refers to the proprietors of the lands on the banks of the river, who will suffer loss, in the event of an accumulation of ice, such as is anticipated taking place by the flooding of their lands. In addition to its advantages, as forming a railway communication, the bridge has been represented as a boon to the surrounding country, by affording at all times the means of a thoroughfare for the public; in which point of view it is favourably contrasted with the present incommodious ferry. But it is obvious that, if the bridge is to serve this purpose, the draw must be kept almost constantly closed, and not, as was represented to us on the ground, shut only when the trains were passing, and open at all other times for the purposes of navigation. Regarding these different views of the subject, however, which are more of a general or public nature, we have not considered it necessary in this place to enter into any details.

Without some definite plan and sections of the proposed structure, it would not be proper to express our opinion as to the practicability of the design. It cannot, however, be denied, that the erection of a bridge of piles, in the situation which has been chosen, must involve engineering difficulties of considerable magnitude. The river, at the point of proposed crossing, is 290 yards in breadth, measured within the low, and 1040 yards within the high-water marks; and the depth in the channel is 18 feet 9 inches at high, and 7 feet at low water. The rise of ordinary spring tides is 11 feet 9 inches, and the velocity of the current, in its ordinary and summer water state, as already stated, varies from 2 to 2½ miles an hour. The result of the borings does not afford a satisfactory prospect of obtaining a proper fixture, as the piles must be sunk through loose gravel and sand into pure quick-sand. A foundation of this kind does not seem well calculated for a structure of such length and height above the water, (21 feet above high, and 32 feet 9 inches above low water.) which is not to be continuous, but to be divided into two independent compartments, with an intervening clear space of 60 feet. It must further be kept in view, that the extremities of these lines of framework must carry the heavy apparatus connected with the drawbridge in the centre, and throughout the whole length, must afford a roadway of sufficient rigidity for the safe transit of a railway train; and when it is further considered that the whole is to be placed in the bed of the largest river in the kingdom, subject to sudden and extensive floods, and pouring down vast sheets of ice at the breaking up of every winter, we think the conservators of the navigation have their grounds of fear for the consequences of such an encroachment on their interests greatly increased.

The foundation for the proposed bridge across the Earn is more favourable, as a fine stiff clay occurs at three feet under the bed of that river.

The works originally designed and since carried into execution, which have been described in the preceding part of this report, were, it will be observed, on a modified scale, devised solely to remove the most prominent obstructions, and facilitate the propagation of the tidal wave in the upper part of the river, which was considered to be the most defective part of the navigation. At the same time, it was evidently the interest of the commissioners to avoid injuring the valuable salmon fisheries of the Tay; and accordingly, the principle on which they have all along acted, has been to execute such works only as interfered as little as possible with the fishing stations, and to extend them over as wide a range of the river as the means at their disposal permitted. The Tay navigation, however, is susceptible of much greater improvement than that contemplated under existing Acts; and now that the effect of the past operations upon the fishings has been found to be unattended with the great detriment which was anticipated, this bar to further improvement which cramped the energies of the commission at the outset, may now be said to be entirely removed.

To those who have studied such objects, it will be apparent, from the facts that have already been stated in the course of this report, that, in forming a design for the further improvement of the Tay navigation, the following facilities which the river possesses, at once present themselves.

1st. A bottom, unencumbered by fixed rock, and composed of materials easily operated on, and yet calculated to retain a permanent form under favourable circumstances, and an undistorted flow of the currents.

2nd. A comparatively straight course without sudden bends.

3rd. A large and constant discharge of fresh water, equalled by no other river in the kingdom.

4th. An extensive influx of tidal waters, rising at Perth, the termination of the navigation, 13 feet at high spring tides, and extending their influence 2¾ miles further up the river.

5th. A large cross section, both as regards breadth and depth, to admit the free passage of those waters in flowing and ebbing through the channel.

6th. The existence of no natural or artificial weirs or dams on the upper part of the river, to limit the further extension of the tidal influence upwards, by means of any works that may be undertaken.

7th. The absence of any bar or natural obstacle before reaching that at the termination of the Firth of Tay, ten miles seaward of Dundee, which has 35 feet of water on it at high water of ordinary spring tides.

8th. A greater fall on the low water in the more seaward part of the river, from Newburgh to Flisk Point, than from Perth to Newburgh.

9th. The comparatively short distance which Perth, the head of the navigation, is removed from the deep water of the large basin of the Firth of Tay.

We think we are fully warranted in stating that, in no case with which we are acquainted, is the same combination of natural facilities held out; and in considering the best means of improving these advantages on a large scale, a subject on which we on a former occasion, reported to the magistrates we shall first advert to the general principles upon which we conceive any extended improvement ought to be based, referring to our observations, made at different times, for the results that have followed the works already conducted by us; and we shall then, in accordance with the same principles, point out what we conceive, under all the circumstances of the case, should be the nature and extent of the operations by which the further improvement of the river may be most economically and surely effected. A chief object contemplated in recommending any works on the Tay, has been to hasten, or render earlier, the flow of the tide in the upper reaches of the navigation, by facilitating the passage of the tidal wave, and at the same time to preserve a sufficient amount of back-water for keeping open the sea channels of the Firth. In obtaining the requisite data as to the particular locality now under consideration, we have at various times, during the last ten years, made minute tidal observations at different stations throughout the river and Frith of Tay. These observations have from time to time, as occasion required, been compared amongst themselves, and their results obtained. But we have found it necessary, with reference to the present more extended inquiry, to analyse the whole afresh, so

APPENDIX C.

PERTH.

No. 127.
Stevenson, on the Tay, and proposed Railway Bridge over the River, near Mugdrum.

as to present the results in a form that may bear on the question under review. This investigation has proved one of considerable labour, and the general results deduced, which we have appended to this report in a tabular form, shew, by the favourable change that has been effected in the tidal phenomena of the estuary, that the works hitherto executed have fully answered the intended end. They also warrant us in holding out a prospect of great additional benefit to the navigation, by the execution of further works. These observations are also interesting, from their bearing on the subject of hydrodynamics, as applied to practical engineering generally. We are not aware, indeed, of any case in which the improvements effected by particular works are more fully and satisfactorily confirmed by a comparison of observations made, previously and subsequently to their execution, than in that of the Tay navigation, where the changes were effected in so short a time, and were so marked, as to leave no doubt, even to superficial observers, of their existence, and no difficulty, by the use of proper means, in ascertaining their amount.

For the details of the tidal observations, we must refer to the appended table, as it would occupy too much space, and is beyond the limits of this report, to analyse the different results, and, by reference to the plan of the river, to enter upon an explanation of them. Three important changes, however, have been effected by the works, to which we should wish to direct attention :—

1st. It will be observed, by an examination of the table, that the fall on the bed of the river, from the tide basin at Perth, to Newburgh, in 1833, was 4 feet; but now it has been ascertained to be only 2 feet.

2nd. In 1833, the passage of the tidal wave from Newburgh to Perth (8·56 miles) occupied 2h. 30m., being at the rate of 3·42 miles per hour, while, since the works were finished, it has been ascertained to be propagated between the same places in 1h. 40m., being at the rate of 5·13 miles per hour, giving a decrease in the time of 56m., and an increase in the speed of the first wave of flood of more than 1¾ miles per hour, since the commencement of the works.

3rd. The spring tides in 1833, at Perth, flowed 2h. 20m., ebbed 7h.; and, at low water, the river ran at its natural level for 1h 45m; but now the tide flows 3h. 10m., ebbs 7h., and stands at low water only 1h., being an increase in the duration of flood of 50m., and a decrease in the time at which the river is uninfluenced by the tide of 45m.

It is almost unnecessary to point out the great advantage derived by the shipping from such a favourable change, especially when viewed in connection with the obstructions that have been removed, and the increased depth that has been obtained by means of dredging throughout the whole course of the river between Perth and Newburgh. The practical result of these advantages has been already pointed out in this report, so that it is unnecessary now to allude to them further; and we shall, therefore, in terms of our instructions, proceed to consider the further improvement of the navigation on an extended scale.

In doing this, it is necessary again to refer to the table of tides for the velocities with which the tidal wave is propagated between different stations on the river, as that forms the surest test of the state of the navigation, the velocity of the tidal wave being decreased in proportion to the amount of obstruction opposed to its ingress. We find, on examining the tables, that the velocity from

Dundee to Balmerino is . . .	18·74	miles per hour.
Balmerino to Flisk	6·06	,,
Flisk to Balmbreich . . .	4·69	,,
Balmbreich to Newburgh . . .	3·86	,,
Newburgh to Carpow . . .	3·17	,,
Carpow to Kinfauns . . .	5·36	,,
Kinfauns to Perth	6·93	,,

From these results it evidently appears, that the part of the river in which the propagation of the tidal wave is now most retarded, lies between Flisk Point and Carpow, and more especially from Balmbreich to Carpow, between which places the average velocity is only 3·51 miles per hour. In the practical working of the navigation, indeed, the deficiency at this place has become more apparent, and is more complained of by shipping since the improvements above have been felt and valued. In the lower part of the navigation, from Balmerino to Flisk, the velocity, as appears from the tables, is 6·06 miles per hour, and in the upper part, from Carpow to Perth, the average is 5·78 miles; so that the intermediate space from Balmbreich to Carpow, being only 3·51 miles per hour, forms a marked contrast to any section of the tidal course of the river that has come within the range of our observations.

Under these circumstances, it is evident that, in any extended view of operations, the part of the river to which attention ought first to be directed, is that between Balmbreich and Carpow, or the top of Mugdrum island, to which, on a former occasion, we directed the attention of the magistrates.

On the first view of the subject it might be supposed, that the division of the tidal stream at Mugdrum island might account for the diminution of velocity in the tidal wave which takes place at that part of the river. But, after duly considering the navigable channel of the south side of Mugdrum island, with reference both to the inclination of its bed and its contour, and taking into account the more generally shallow and varied depth and irregular cross-sectional area of the north channel, we are of opinion, that the retardation of the first tidal wave of flood is to be accounted for—not by the division of the stream into two channels, but by the obstructions opposed to its progress in the present south or navigable channel, from Balmbreich to Carpow, as compared with that of the upper and improved part of the navigation.

The obstructions in the part of the navigation to which we refer are of two kinds; namely, the amount of fall on the bed of the river, and the rugged and tortuous outline of channel along which the tidal wave is propelled; and to each of these particulars it will be necessary to allude.

The rise on low water, as may be easily imagined, forms, in proportion to its amount, a serious bar to the propagation of the the tidal wave; and we have the following results with reference to this point given in the tables. The rise on low water spring tides, from

	Ft.	in.		Slope.	
Flisk Point to Balmbreich is .	0	4	or	1·95	inches per mile.
Balmbreich to Newburgh .	2	8	,,	9·35	,,
Newburgh to Carpow .	0	5	,,	3·75	,,
Carpow to Perth . . .	1	7	,,	2·63	,,

APPENDIX C.

PERTH.

No. 127.
Stevenson, on the Tay, and proposed Railway Bridge over the River, near Mugdrum.

From these results it appears, that between Balmbreich and Newburgh, there is a rise of 9·35 inches per mile, being nearly three times greater than on any other part of the navigation; and a corresponding amount of retardation may consequently be expected to follow. The other obstructions referred to are even, perhaps, of a more serious nature: many jetties had, from time to time, been projected into the navigable channel from the south shore, for purposes connected with the interests of the proprietor of the land. These jetties (before alluded to) which, as decided in a late law plea between Lord Zetland and the conservators of the river, are now in the process of being removed, under a decree of the Court of Session, extended so far into the navigable channel as to prove great obstacles to the flow of the tide, which was amply exemplified in the alternate shallows and deep pools occasioned by them; and even now, although great part of them has been removed, the tortuous and irregular channel caused by their projection into the fairway, has not yet been brought into train.

As regards the upper part of the river, the result afforded by the tidal observations is so favourable that little more is required than additional depth to produce a corresponding amount of acceleration.

The works we propose for the further improvement of the navigation consist of two departments. For the lower part of the river we recommend the formation of a line of conservation for the margin of the channel, by the erection of a system of "rubble-walling," instead of the present irregular and broken line of shore, formed by the protrusion of jetties into the stream. From our knowledge of the effects of similar operations on other navigations with which we have been professionally connected, we have no hesitation in saying, that, were such a wall as we propose carried in a judicious line of direction, from a point near the junction of the Earn to a point at or near Flisk Point, the level of the low water between Newburgh and Balmbreich would soon be lowered, and the present obstruction to the passage of the tidal wave being removed, its propagation would be greatly accelerated. This change would, of itself, operate beneficially on the whole line of navigation to Perth, at which place the first of flood would be hastened in proportion to its earlier appearance at Newburgh, while the scour would be rendered more effective. In connection with this work, we recommend for the upper part of the river the continuance of dredging, the beneficial effects of which on the channel of the Tay are still far below their limits. From calculations we have made, we are of opinion, that by the removal of a quantity of material, not much exceeding that already raised, and the construction of the walling alluded to, a depth of from 19 to 20 feet, at highwater of ordinary spring tides, up to Perth, would be obtained; and by continuing these operations, the depth might be still further increased. It will be observed, that these improvements could be carried out without abstracting, or in any way interfering with the back-water of the river, which would even be somewhat increased; and thus the sea channels of the Firth would be improved, and all questions as to injuriously affecting other interests would be avoided.

It is not possible with our present information, to form anything but a rough approximation to the expense of the works we have sketched out. But we are of opinion that the "rubble-walling" between the Earn and Flisk Point, and the dredging to obtain the proposed depth of from 19 to 20 feet, would be executed at a cost of from 45,000*l.* to 50,000*l.*

The establishment of wet docks at Perth, as proposed in our report of 1834, and partially executed, could not fail, in connection with such an improvement in the navigation as we have pointed out, to be attended with great advantage, both to the city of Perth, and to the whole surrounding district of country; but it is almost unnecessary, in conclusion, to observe, that such works seem wholly incompatible with the erection of the proposed bridge at Mugdrum.

ROBERT STEVENSON & SON.

The Lord Provost, Magistrates, and Town Council, Perth.

Results of Observations made at various times, from 1833 to 1844 inclusive, on the Tides of the River and Firth of Tay, by Robert Stevenson & Son, Civil Engineers.

I. *Propagation of Tidal Wave.*

TABLE of elapsed times, between arrival of the tide wave at the following stations, during spring tides in 1833 and 1834, shewing the rate of its propagation:—

	Times. H. M.	Distance in Miles.	Rate of Tide Wave in Miles per Hour.
Dundee to Balmerino	0 16	5·00	18·75
Balmerino to Flisk Point	0 29	2·93	6·06
Flisk Point to Balmbreich	0 26	2·04	4·69
Balmbreich to Newburgh	0 53	3·42	3·86
Newburgh to Perth (tide harbour)	2 30	8·56	3·42

The result of observations made in 1842, 1843, and 1844, give the same velocity between Dundee and Newburgh, and the following rates between Newburgh and Perth:—

	Time. H. M.	Distance in Miles.	Rate of Tide Wave in Miles per Hour.
Newburgh to Carpow	0 25	1·33	3·17
Carpow to Kinfauns	0 55	4·92	5·36
Kinfauns to Perth (tide harbour)	0 20	2·32	6·93
Giving, as a mean for the whole distance from Newburgh to Perth in 1844	1 40	8·56	5·13
Time from Newburgh to Perth in 1833	2 30	8·56	3·42

Thus shewing an increase in the velocity of the tide wave of more than 1¼ miles per hour, as the result of the improvements.

N.B.—The elapsed time in neap tides at present, between Newburgh and Perth, is 1h. 53m.

APPENDIX C.

PERTH.

No. 127.
Stevenson, on the Tay, and proposed Railway Bridge over the River, near Mugdrum.

II.—*High-Water Level.*

The levels of the surface of high water at different stations throughout the river have been found to be unchanged, and the following results refer to the years 1833 and 1844:—

From Flisk Point to Balmbreich there is a fall of . . .	5	inches.	Spring Tides.
From Balmbreich to Newburgh there is a rise of . . .	7½	„	
From Newburgh to Perth (tide harbour) there is a rise of . .	12	„	
From Flisk to Balmbreich there is a fall of	2½	inches.	Neap Tides.
From Balmbrich to Newburgh there is a rise of . . .	6	„	
From Newburgh to Perh (tide harbour) there is a rise of . .	12	„	

III.—*Low-Water Level.*

Rise on the surface of low water (spring tides) in 1833:—

	Ft.	In.	Distance in Miles.	Rate of Slope per Mile in Inches.
Flisk to Balmbreich there is a rise of . .	0	4	2·04	1 95
Balmbreich to Newburgh, rise of . . .	2	8	3·42	9·35
Newburgh to Perth (tide harbour,) rise of .	4	0	8·56	5·06
Rise on the low water of spring tides in 1844:—				
Newburgh to Carpow there is a rise of . .	0	5	1·33	3·75
Carpow to Perth there is a rise of . . .	1	7	7·23	2·63
Hence from Newburgh to Perth in 1844 . .	2	0	8·56	2·80

N.B.—The result of the observations of 1844, gives a depression on the level of the low-water mark on the gauge, of 2 feet at Perth tide harbour.

IV.—*Duration of Flood and Ebb.*

THE results of observations in 1833 and 1844, at Newburgh, shew that the duration of flood and ebb tides at that place are unchanged. The times are as follow:—

	H. M.		H. M.
Spring tides flow . . .	4 20	Neap tides flow . . .	4 30
„ ebb . . .	7 20	„ ebb . . .	6 45
At Perth in 1833,—		At Perth in 1844,—	
Spring tides flowed . .	2 20	Spring tides flow . .	3 10
„ ebbed . . .	7 0	„ ebb . .	7 0
Neap tides flowed . . .	3 15	Neap tides flow . .	3 10
„ ebbed . . .	7 0	„ ebb . . .	7 0
		Increase of duration of flood at Perth	0 50

In 1833 the river at its natural level at spring tide	1 45
In 1844 its runs at its natural level at spring tide	1 0
Gives a decrease in the time of standing at low water, or in the absence of tidal influence at Perth at spring tides, of . . .	0 45

No. 128.
Rendel, on a Bridge over the Tay at Mugdrum.

No. 128.

Report by JAS. M. RENDEL, Esq., C.E., *on a Bridge over the Tay at Mugdrum.*

8, *Great George Street, Westminster,*
February 5, 1845.

SIR,

RELATIVE to the bridge proposed to be built across the navigable part of the river Tay, below the city of Perth, I have to report, for the information of the Lords Commissioners of the Admiralty, that in compliance with their commands, communicated in Sir John Barrow's letter of the 16th September last, addressed to me in Edinburgh, I proceeded to inspect the site of the proposed bridge on the 18th, attended by Mr. Miller, the engineer for the Railway Company promoting it, and Mr. Stevenson, the engineer for the Harbour Commissioners of Perth, who are opposing it.

As it appeared, on careful inspection, that detailed surveys of the river at the site of the proposed bridge were necessary to enable me to comply with their Lordships' instructions, I suggested that time and expense would be saved by both parties entrusting the survey to some person on whose accuracy and impartiality they could rely. This suggestion was not, however, acted on; and it was not till the 9th December last that the required plans, &c. were furnished by the Railway Company, whilst those made by the Navigation Commissioners were not transmitted till the 11th ult., nor the full information till the 27th. The delay, therefore, of this Report rests with the parties themselves.

The Tay is navigable up to Perth for vessels drawing 14 feet of water. The bridge is proposed to be carried across the river about 7 miles below the city. Its roadway to be 22 feet above high water, but provided with a drawbridge, 60 feet wide, placed in mid-channel for the passage of ships.

It is manifest that such a bridge would be an obstruction to the navigation. The degree and its justification are therefore the points for consideration.

The site of the proposed bridge is about half a mile below the junction of the river Earo with the Tay, up to which the Firth of Tay may be said to extend. The junction of these two considerable rivers, at the head of an exposed estuary much encumbered with sands, occasion an accumulation of banks and a distortion of currents to an extent that makes the navigation troublesome and precarious. A bridge on such a part of the river must, therefore, be more objectionable than in any other, for its piers must cause increased distortion of the currents, and give rise to greater uncertainty in the position of the banks and depth of the navigable channel. By the plans made for this inquiry, it appears that the tidal currents at present vary in velocity from 1½ to 2½ miles per hour, whilst the borings show that the bed of the river is composed of fine running sand (of a great depth), covered with a thin coating of small gravel. It is, therefore, to be apprehended that a small increase of current would be sufficient to disturb ground of this description, particularly in time of land floods, and when the river is loaded with ice.

No. 128.
Rendel, on a Bridge over the Tay at Mugdrum.

The designs for the bridge meet these objections as skilfully as possible, having reference to expense. Instead of the usual bulky stone piers for supporting the roadway, clusters of wood piles are substituted, carrying arches of 50 feet span. One design shows the whole width of the river passed in this manner, the other has short solid embankments on each shore; the former is of course to be preferred. Still I am of opinion that even a bridge of this construction would increase the number of banks, and add to the intricacy of the navigable channel for some distance above and below it, and especially in the line of the drawbridge; for the piers to carry these moveable parts must be made more bulky than the others, and of greater solidity, to provide against damage when struck by vessels in their passage through.

Under favourable circumstances, fore-and-aft rigged vessels might pass through under canvas, but it is doubtful whether a square-rigged ship would attempt it. By night or in bad weather, or with foul winds, no vessel would attempt to pass any other way than by warping. In blowing weather the width and exposure of this part of the estuary would make a passage difficult and dangerous without the aid of a steam tug.

The Railway Company very properly propose to provide, at their own expense, such a tug vessel, to be in attendance at the bridge to take vessels through, and they further propose that the drawbridge shall only be closed during the passage of the trains.

A strict fulfilment of these proposals would I think prevent danger, and as far as possible injurious delay, to the passage of vessels through the bridge.

The probable injury, however, to the depth and maintenance of the navigable channel through the drawbridge is not, nor do I see how it can be met, and this seems to me the most serious objection advanced by the Perth Harbour Commissioners.

By their statement, it appears that, since 1834, they have expended on the improvement of the channel of the Tay between Newburgh (about two miles below the proposed bridge) and Perth upwards of 53,000*l*. That this sum has been raised on the security of the city revenues; that by it the river has been deepened, so that ships of 14 feet draft of water can now come up to Perth; that the trade of the port has increased to the full extent of their expectations; that their river is capable of very much greater improvement; that the present pause in the prosecution of the works is a necessary compliance with their Act; that in a year or two they intend to resume them; that the magnitude of the Tay, and the favourable nature of its bed for deepening, make the work of improvement in their care as successful in its result as similar works have been in the Clyde; that railways are at present projected which will make such improvements certain, and constitute their port one of great importance: but that the construction of the proposed bridge would stop these improvements, endanger their present income and means of discharging the debt on the navigation, and probably injure the fisheries in the higher parts of the river, for which they would be made liable in consequence of clauses in their Act.

The Railway Company urge the importance of the bridge, as a means of saving 11 to 12 miles in distance between Edinburgh and Dundee, and the other important ports and towns on the north east coast; that this saving of distance is of national importance, on account of the number of passengers and extent of goods and traffic that will be conveyed; that carrying the line round by Perth would increase the cost of coals which they expect to carry from the mines in Fife to the consumers in Dundee, to the great injury of the trade of that important manufacturing town, and that they are prepared to meet the objections to the proposed bridge by any alterations in its design which the Lords Commissioners of the Admiralty may deem necessary, provided the cost does not exceed their means.

It appears on investigation that these respective statements deserve full consideration in deciding the question at issue.

I am quite satisfied that the bridge would be so far an impediment to the navigation as to make its further improvement improbable.

I also think that, in connection with the rivalry which the railway would establish, the present revenue of the Harbour Commissioners would be considerably lessened, and the discharge of the debt incurred in the improvements of the river made precarious. On the other hand, I think the objection of the Railway Company to the lengthening of their line, by taking the circuitous route through Perth, a well-founded one.

Under these circumstances it is for their Lordships to determine which of the two interests should yield.

The *national* importance of the railway is, in my opinion, much impaired by its being intercepted by an exposed ferry of three miles in length across the Frith of Forth, and the certainty which exists of a rival line being made by Stirling. This line will, it is true, be 38 miles longer from Edinburgh to Dundee than the line by the proposed bridge, but it will not be interrupted by a ferry, which in this case would certainly be equal in time to an additional 20 miles of circuit at least; and for the conveyance of mails, troops, and a numerous class of passengers, the longer line without a ferry would be preferred to the shorter line, with one even improved as this ferry has been of late by the establishment of powerful steam-vessels, and the construction of convenient low-water piers at Granton and Burntisland. That a railway will be made from Dundee to Perth, along the north bank of the Tay, there can be little doubt. One of the companies promoting the proposed bridge has deposited an alternate line on this route: with that railway the navigation of the Tay may fairly be allowed to compete. It does, however, seem to me absolutely necessary to its chance of success that it should not be interrupted by a bridge, more especially as the bridge is to be made and regulated by parties interested in the competition.

Fully satisfied of the great local, if not national, importance, of this proposed railway, and of their Lordships' desire in all cases to avoid unnecessary opposition, I have most anxiously attended to that part of their instructions which directs me to point out such alterations in the intended works as would, in my opinion, prevent them from injuring in any way the navigation of the river, while they may meet, as nearly as they can, the designs of the Railway Companies. I have failed, however, to discover any plan less objectionable than that proposed. I refer to the design having arches from shore to shore. It is probable that higher up, where the river is narrow, and has a sound bed and a well-defined and permanent low-water channel, a very much less objectionable site might be found; but this would increase the length of the railway as between Edinburgh and Dundee, &c., which the company consider an evil.

Of course it is quite *practicable* to carry the bridge across the navigable channel of the river, with a sufficient width and height for vessels to sail freely through; but, having reference to expense, I do not think such a plan feasible.

Under all these circumstances, therefore, and regarding the great improvements of which I think the Tay capable for its whole length from Dundee to Perth, and the beneficial effects that beyond question

Appendix C.

Perth.

No. 128.
Rendel, on a Bridge over the Tay at Mugdrum.

would result from such improvements in the removal of banks, seaward of the harbour's mouth, I can only express my opinion that their Lordships cannot decide in favour of this or any similar bridge below the shipping berths at Perth, without injury to the present trade of the river, the almost certainty of preventing the further improvement of the navigation, and establishing a precedent that would make it difficult to refuse future applications for similar encroachments on the other great estuaries of the country.

I beg to return the several papers received from the Admiralty, also the plans of sections furnished by the parties interested in the inquiry.

I have, &c.,

To the Secretary of the Admiralty.

J. M. Rendel.

No. 129.
The Memorial of the Harbour and Tay Navigation Commissioners to the Tidal Harbours Commissioners, 1845.

No. 129.

The Memorial of the Harbour and Tay Navigation Commissioners to the Tidal Harbours Commissioners, 1845,

Sheweth,

That the memorialists are commissioners acting under the authority of an Act passed in the eleventh year of the reign of His late Majesty King George IV., and first year of the reign of His late Majesty King William IV., intituled "An Act for enlarging, improving, and maintaining the Port and Harbour of Perth, for improving the Navigation of the River Tay to the said City, and for other purposes therewith connected," and of another Act passed in the fourth and fifth years of the reign of His late Majesty King William IV., intituled "An Act to alter and amend the foresaid recited Act," and of another Act passed in the second year of the reign of Her present Majesty, intituled "An Act to alter, amend, and enlarge the powers and provisions of two several Acts of the eleventh year of the reign of King George IV., and first year of the reign of King William IV., and fourth and fifth year of King William IV., for improving the Port and Harbour of Perth and the Navigation of the River Tay to the said City."

That under the directions of the memorialists, and under the authority of those Acts of Parliament, the navigation of the Tay from a little below the bridge of Perth downwards has been greatly improved by deepening the river, and by forming a tide harbour adjacent to the city of Perth, with roads and accesses to the same; and divers large sums of money have been expended on this account to an amount exceeding 53,000*l.* in the whole; and it is intended still further to continue the improvements of the navigation, and of the harbour of Perth, in terms of the powers conferred by the said Acts.

That a Bill is presently depending in Parliament, intituled "An Act for making a Railway from the Royal Burgh of Dundee to the Royal Burgh or City of Perth, to be called the Dundee and Perth Railway."

That it is proposed by the said Bill to carry the said intended railway across the Tay by means of two bridges, the one to be erected across the main channel about 750 yards below the present bridge of Perth in the centre of the old part of the harbour of Perth, and the other to be erected across the Willowgate branch of the said river at the bottom of the Friarton island.

That the memorialists have experienced considerable difficulty in obtaining inspection of the plans according to which the said bridges are to be constructed, so as to afford the means of judging how far their interests are likely to be affected thereby; and it is only now that they are in possession of sufficient information to enable them to address your Board on the subject.

That by the erection of the foresaid bridges, and by the formation of the said railway, the rights and interests of the memorialists will be seriously affected, and great loss and damage will be occasioned to them, in consequence of which they are induced respectfully to solicit the interference of your Honours on their behalf.

That the Lords Commissioners of the Admiralty on examining the plan showing the proposed crossing of the river Tay at Perth, caused an official intimation to be made to the chairman of the said railway company, that no bridge can be thrown across the Tay at or near to the place marked on the plan, which will not entail more or less mischief on the river, and considerable inconvenience to the water traffic which goes up to the city of Perth, and that their Lordships would strongly recommend the promoters of the said railway to carry their trains across the river by means of a steam ferry, there being several places between Cannie Point and Friarton island where such a ferry would advantageously work, by which means the said railway company would save the expense not only of a long and costly bridge, but also of a considerable length of railway, and would avoid all risk of interfering with the navigation, or of preventing the improvements of the Tay, and that if this plan were adopted, their Lordships would cheerfully yield every reasonable facility for the formation of the requisite wharfs.

That their Lordships further intimated to the foresaid parties, that if, notwithstanding the evident advantages before enumerated, they would still persist in the intention of crossing the Tay by means of a bridge, their Lordships would consent to such an erection, but only on certain specified conditions, two of which are, that before any part of the foresaid work be begun, working plans and specifications must be submitted for the approbation of their Lordships, and that the whole question of such a construction must be subject to the revision of your Board.

That, notwithstanding of the recommendation of the Lords of the Admiralty, and of the undeniable grounds on which it proceeds, the promoters of the said railway have intimated their intention not to effect the crossing of their trains by means of a ferry, but by means of bridges erected across the Tay, at Perth, and they are at present carrying through Parliament a Bill to confer the requisite powers on them for that purpose.

That, by the formation of the said railway in the manner contemplated by the said Bill not only will the navigation of the Tay be impeded, but the memorialists will be deprived of a large portion of the revenue presently available to them for the execution of the statutory operations, and the railway company will be enabled to take possession of a large portion of the navigable channel of the Tay without making any compensation therefore, unless your Board shall be pleased to interfere in the manner prayed for.

That the navigation and harbour dues presently derived by the memorialists from goods and vessels passing betwixt Dundee and Perth alone amount to not less than 700*l.* annually, and the promoters of the said railway have laid evidence before a committee of the House of Commons, to whom the Bill had been referred, to shew that they will absorb the whole of the said traffic at the expense of the memorialists.

No. 129.
The Memorial of the Harbour and Tay Navigation Commissioners to the Tidal Harbours Commissioners, 1845.

That if the memorialists are thus deprived of so large a portion of their revenue they will not only be prevented from carrying into effect the further improvements of which the navigation of the Tay is still susceptible, but they will be unable, from want of the requisite funds, to maintain the navigation in its present state, and to uphold the piers and other works constructed by them in virtue of the foresaid Statutes.

That in these circumstances the memorialists beg leave humbly to make the following application:—

May it therefore please your Honours, on considering what is above set forth to refuse to sanction the plans and operations of the said railway company, unless upon condition of their paying such a sum as your Honours may consider reasonable to be expended in the improvement of the navigation of the Tay, and in upholding the works constructed in connection therewith; and to do further and otherwise in the premises as to your Honours may seem meet. And your memorialists will ever pray.

C. G. SIDEY, *Lord Provost,*
And Chairman of the Perth Navigation Commission.

1845.

No. 130.
Statement of receipts and expenditure under Acts 1830–46.

No. 130.

Statement of Sums received and expended under the Perth Navigation and Harbour Acts from 1830 *to September* 12, 1846.

Sums expended.

			£. s. d.	
Expense of Acts			4,673 0 9	
Expense of jury trial			258 18 9	
Price of ground			815 10 6	
Cranes			150 0 0	
Roads. paid D. Pearson		£ 685 10 4		
Metal, &c., to May 9, 1838		782 2 3		
Ditto to September 12, 1846		2,290 8 9		
			3,758 1 4	
Printing and advertising			62 16 4½	
Piers and tide harbour			12,237 5 0½	
Deepening river			24,251 6 1	
Miscellaneous expenses			8,996 16 4	
Compensations paid to proprietors of fishings			5,605 18 9	
Expenses opposing railway encroachments on river and harbour			1,108 4 5½	
				61,917 18 4½
Sums received.				
Amount drawn of shore-dues		36,757 14 7		
Amount drawn for cranes, gravel, &c.		634 7 5½		
Berthing-dues, 1837		26 13 0		
Punts sold		150 0 0		
			37,568 15 0½	
Deduct.				
Proportion of shore-dues paid city		3,389 10 8½		
Amount of interest paid on bonds		14,520 5 2		
Amount of interest paid to bank		1,323 13 11		
			19,233 9 9½	
			18,335 5 3	
Borrowed on bonds		40,030 8 2		
Due to the bank	£ 3,570 0 0			
Deduct cash on hand	17 15 0½			
		3,552 4 11½		
			43,582 13 1½	
				61,917 18 4½

P. CHAPMAN, *Treasurer.*

Perth, Oct. 1, 1846.

No. 131.
Return of Income and Expenditure, for the Years 1842, 1843, and 1844.

No. 131.

Return of Income and Expenditure for the Years 1842, 1843, *and* 1844.

Income.	1842.	1843.	1844.	Expenditure.	1842.	1843.	1844.
	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.	£ s. d.
Crane dues, &c.	128 0 8½	46 0 10½	40 18 6	Salaries and miscellaneous expenses	626 10 4	625 0 9	513 19 3
hore dues, &c.	3200 3 7	3306 1 2	3317 1 4½	Deepening the river	1181 18 6	497 16 10½	114 0 5
				Repairs of piers and shore roads	396 10 11	257 5 11	265 8 10½
				Proportion of shore dues paid to the town of Perth	205 6 0	271 15 7	273 12
				Interest on money borrowed	1475 15 5	1514 12 3	1392 5 6
				Compensation money, for supposed injury done to the salmon fisheries by deepening the river	53 4 0	722 4 0	836 5 0
Total	3328 4 3½	3352 2 0½	3357 19 10½		4029 5 2	3889 18 4½	3400 11 2½

N.B.—The authority under which the above dues are levied is the Act of Parliament 4 & 5 Will. IV., cap. 67.

Debt due on the 31st December, 1845, 43,070*l.*

P. CHAPMAN, *Treasurer.*

Perth, November 26, 1844.

APPENDIX C.

DUNDEE.

No. 132.
Evidence taken on the 2nd Oct., 1846.

DUNDEE.

No. 132.

Examining Commissioner—Captain WASHINGTON, R.N., F.R.S., assisted by Captain VEITCH, R.E., F.R.S., Admiralty Engineer.

Present—The PROVOST OF DUNDEE; LORD KINNAIRD; VISCOUNT DUNCAN, M.P.; Sir JOHN OGILVY, Bart.; Mr. G. DUNCAN, M.P.; Mr. D. HUNTER, of Blackness; Bailies ANDERSON, STURROCK, MOYES, and HEAN; Mr. J. WEBSTER; Mr. W. THOMS, Dean of Guild; Mr. D. BAXTER; Mr. A. LAWSON; Mr. A. MARTIN; Mr. A. LOW; Mr. T. POWRIE; Mr. J. KENNEDY, Jun., Master of the Trinity House; Mr. W. HARRIS; Mr. R. HARRIS; Mr. A. EASSON; Mr. P. H. THOMS, Mr. G. H. NEWALL; Mr. A. MONCUR; Mr. A. LOW; Mr. C. SMITH; Mr. I. J. HENDERSON; Mr. A. CLAYHILLS; Mr. A. BALFOUR; Mr. J. NEISH; Mr. W. D. PROCTOR; Mr. J. SMITH Mr. W. BARRIE; Mr. T. NEISH; Mr. D. CRIGHTON, Surveyor for Lloyd's; Mr. W. CLARK; Mr. C. NORRIE; Mr. J. M. LINDSAY; Mr. A. ALLARDICE; Mr. G. MILNE, Mr. JACK, &c. &c.

The COMMISSIONER, having read the Royal Commission, stated, that this was a public inquiry into the past and present state of the port of Dundee, and its capabilities for improvement; and it was in order to bring out as much information as possible on these points, and to give every one interested an opportunity of stating his opinion, that the meeting was called.

Mr. MILNE, clerk to the harbour trustees, examined.—The harbour was vested by charter of date 1641, in the magistrates and council, up to the year 1815. That, so far as he knew from the records, the inhabitants were for some time not satisfied with the management of the corporation. That in 1814 and 1815 various meetings of public bodies were held for the purpose of adopting steps to force the magistrates and council to institute a more liberal system of government; and by these means the Act of 1815, which was the first Harbour Act, was obtained. By that Act the newly appointed Commissioners were empowered to borrow 40,000*l.* He was not aware of there having been any debt previous to 1815. The harbour works were then begun. Additional improvements were shortly afterwards found necessary and more works required, and power was given to borrow an additional 10,000*l.* The next Act, which was passed in 1830, repealed these two previous Acts. Larger powers for improving the harbour were bestowed, and power was also granted to borrow additional sums, to the extent in all of 180,000*l.* The next Act applied for was in 1836, when it was again found necessary to provide for further extending the works; and for this purpose a further sum of 50,000*l.* was required, or in all, 230,000*l.* The Act of 1843 was intended chiefly to remedy defects in the details of the previous Acts, and to arrange the schedule of rates; and power was given by it to borrow an additional 20,000*l.* That money has not all been borrowed. At the close of the financial year (31st of May, 1846) there remained to be borrowed 7251*l.* 8*s.* 3*d*, the whole money borrowed amounting to about 243,000*l.* 50,000*l.* bears interest at the low rate of 3½ per cent., and the rest at 4 per cent.—the interest being 3000*l.* less than it was in 1843. By the last Act a sinking fund was brought into operation; debt to the amount of 17,411*l.* has already been paid off, and the extinction of the debt is going on progressively, the sum specified by the Act being paid into the bank monthly, the trustees having no control over it beyond selecting the bonds to be cancelled. By the last Act, the principal alteration in the schedule of rates was to increase the dues on goods sent outwards, and in various instances to decrease them on goods imported. With a few exceptions there have been no formal complaints against the rates. The complaints have generally been with regard to grain and skins; and they have always been carefully considered. In regard to grain, no alteration could be made, as the schedule in the Act is imperative. The dues on skins are not imperative in all cases.

The Board consists of 21 trustees—6 from the Town Council, 6 from the Guildry, 3 from the Nine Incorporated Trades, 1 from the Three Trades, 1 from the Trinity House, and 4 from the County. The members are all elected annually, with the exception of the provost and magistrates, who are trustees *ex officiis.* Three of the 21 trustees at present are sailors. The Board does not examine pilots. It licenses them, but is bound to refer their application to the Trinity House. It cannot license unless the Trinity House certify to their fitness. There have been no complaints of the want of pilots or buoys or beacons on the river. Any complaints would be attended to immediately. It is not compulsory in vessels to take pilots. The harbour trustees have no power to enforce such a regulation. He was not aware of any letter being received in reference to compulsory pilotage. Seven trustees form a quorum of the harbour board; and it is very rare indeed that a quorum is not obtained. It will not happen three times out of 200 meetings called. Business receives the most prompt attention from the harbour trustees.

The COMMISSIONER inspected the minute books, record of bonds, and books of letters received and written, and stated that so far as a cursory inspection of the books enabled him to judge, the way in which they had been kept was quite satisfactory, and that they did much credit to Mr. Milne. He requested that this opinion might be intimated to the harbour trustees, and inserted on their minutes.

Mr. MILNE stated that, in reference to the subject of a floating light, a committee of the whole Board had been for some time considering the cause of the accidents at the mouth of the river. Mr. Hunter of Blackness was convener, and had drawn up a draft of a Report, but it had not been considered by the Committee. Considerable diversity of opinion prevailed at the Harbour Board on the subject of a light-vessel. The lights are not under the power of the trustees, but of the Trinity House.

Provost BROWN stated that no communication had been received on the subject of a floating light; but Captain Greig of the *Britannia* steamer had spoken to him about it, and strongly urged him to impress on the Harbour Board the necessity of a floating light. The reasons he assigned were the great advantage of such a light in case of foggy weather. That was the only complaint which he had received as to the want of such a light, and it had been merely made verbally.

The COMMISSIONER suggested that there should be a correct list kept of the wrecks and casualties occurring at the banks of Tay. The master or any of the crew of a wrecked vessel should also be examined when they came on shore. In this way they would be much more likely to decide the question of the want of a light or the contrary than by any discussion. There would be no great trouble in adopting such a measure.

Provost BROWN mentioned that the harbour master had instructions to report on all accidents.

Mr. CAIRNCOSS, harbour treasurer, bore evidence to the manner in which his books were inspected

Appendix C.

Dundee.

No. 132.
Evidence taken on the 2nd Oct., 1846.

by the Harbour Board, and as to the duties of the auditor, who is entirely unconnected with the Trust being appointed annually by the sheriff.

The **Commissioner** wished to understand the powers of the auditor. Suppose the trustees were to spend money illegally, had he power to check it? To put a case—Suppose the trustees were to spend 500*l.* in building a church, where would the controlling power lie?

Mr. **Milne** explained that, if the trustees were to exceed their power, an action would lie in the Court of Session. (See App. No. 157.)

The **Commissioner** said that if it really was so, it was entirely satisfactory.

Mr. **James Leslie** had been 14 years resident engineer of the harbour, from 1832 up to Whitsuntide last.—The first work of which he knew was King William's Dock, then Earl Grey's Dock, and then the Victoria Dock.[1] Earl Grey's Dock gates admitted the largest steamers frequenting the port, the breadth of the lock being 55 feet, and the distance between the gates 210 feet. There were four large berthing sheds. There was a great tendency to silt up in the harbour, the silt being principally brought down the river. This was kept down by dredging and scouring. A point of rock to the westward at the Magdalen Green was rather injurious, but still there was a considerable scour. There were steps taken by an arrangement betwixt the Harbour Trustees and Dundee and Perth Railway to have this rock removed, but the clause was thrown out in Parliament. He had observed the ballast bank for four or five years beginning to turn outwards. The embanking of the Dundee and Arbroath Railway had proved injurious, from its being formed partly of loose stuff thrown down within high-water mark. The entrance to the harbour had a tendency to shoal some years ago, but not now. If the Beacon rocks could be removed at a moderate expense, it would be a great matter; but the expense would be very serious, and unless they could remove them down to the level of the wet dock, they would be better as they are. There had been encroachments on the river all the way from about Powgavie up the river, the object of which was to make land, and the effect of which was injurious to the scour. Any encroachment or projection at the neck at Broughty Ferry would be dangerous to the navigation. There is a depression of from 3½ to 4½ inches between the level of the ocean at Carnoustie and at Dundee. The winds have some influence on this. The deepening of the channel below Perth did not carry up much more tidal water. The Dundee and Perth Railway had not proved injurious, as, although it displaced water, it made the scour more effective. The most beneficial measure would be to let more water in. If the Horse-shoe Shoal at Broughty Ferry were cut away to the level of low water, it would be of advantage. The estuary of the river Tay, after an experience of 14 years, he considered would require constant watching. He had no opinion to express regarding a bridge at Mugdrum. If it was built high enough and wide enough, there would be no injury. Would not undertake to build it high enough and wide enough. The salmon nets do no injury to the navigation. Stake nets are not allowed within the Abertay Bank. There had been no material change in the sand-banks. Did not know when the Buddon-ness Lights were first erected. Did not know of any vessel at any time sailing eastward with the Craig Lights in one. There is no want of harbour accommodation at Dundee, although no doubt it would be of great importance to have the contemplated works completed. The trade of the port has increased with the increased accommodation.

Mr. **Thomas Neish** wished to ask Mr. Leslie if he had any instructions to report on the bank out from the Magdalen Yard. His house was in the immediate neighbourhood, and he had observed that since the commencement of the works of the Dundee and Perth Railway, it had grown five or six times as large as it was years ago. It was much altered. Instead of a narrow bank, the Ballast Bank, as it is called, was a complete field of sand.

Mr. **Leslie** said the bank referred to was much farther from the harbour than it was some years ago. It was not extending. It was not so bad as it was in 1845. It may have increased in breadth, but it is not so far down—not so near the harbour

Mr. **Neish** insisted he was right, and that his opinion was supported by two pilots, David Kidd and some other person. His wish was to call the attention of the trustees to it.

Mr. **Kennery** did not think the Middle Bank had come lower down. The persons who cross the river regularly would be the best to give information upon it.

Mr. **Ower** had been acquainted with the harbour eleven years, and resident engineer seven months. He corroborated the statements which had been made by Mr. Leslie. He had considered the proposed crossing at Broughty Ferry, and was strongly opposed to any encroachments on the river there. Thinks they would be prejudicial to the navigation. He had surveyed the above this past summer, of which he handed in a copy to the Commission. The low-water mark on the survey had been laid down in 1844.

Mr. **Leslie**.—The point at Broughty would be a very bad place for a ferry pier. The tide runs through the gorge at the rate of four miles an hour.

Mr. **Ower** continued.—There are 2½ feet of water between the harbour heads at Dundee at low water. There had been three months' dredging this year at the tide harbour. He was continuing the survey of the Ballast Bank at the present time.

The **Commissioner** said the document on which Mr. Ower had laid down the extent of the Ballast Bank each year was a very valuable one. It showed the advantage of a resident intelligent engineer, he being at the same time a competent nautical surveyor. He wished him to send a tracing to the Tidal Commission.

Mr **Charles Norrie** and Mr. **Spence** appeared with a petition from the owners of bleachfields and others in the neighbourhood of Broughty Ferry, complaining of the want of a proper landing place there, and of the high dues exacted by the Dundee Harbour trustees. All the accommodation at Broughty Ferry consisted of three pawls and three iron rings, whereas, were there proper accommodation, it would be well adapted for the shipping of agricultural produce.

Mr. **Robertson**, the collector, explained that only half tonnage dues and half dues on the cargo were charged for coals, lime, and manure at Broughty Ferry; and that the whole dues collected for the last year from Broughty Ferry, Monifieth, &c., amounted to 89*l.* 17*s.* 7*d.*, and about three-fourths of this was charged on those articles which only paid half dues.

Mr. **Milne** said that, in addition to what Mr. Robertson had stated, he was bound to say that some of them who were now blaming the Harbour Trustees were the very persons who prevented improvements from being made. A feuing plan of part of the bed of the river had been got up by the proprietors in Broughty Ferry, and several portions of the ground within high-water mark had been actually sold for building for a perpetual ground rent. They thus claimed the bed of the river, and would permit no interference by the trustees, who in consequence brought an action in the Court of Session to vindicate

APPENDIX C.
—
DUNDEE.
—
No. 132.
Evidence taken on the 2nd Oct., 1846.

the public right. That case is not yet decided, but he could inform Mr. Norrie that there was now every prospect the trustees would succeed. Again, some time ago, the trustees put up several strong stone pawls for mooring ships, and these had been destroyed. Every obstruction had been offered by the parties referred to, and he believed Mr. Norrie was one of them.

Mr. **NORRIE** denied that he was one of the party referred to. He had no interest in the property at the time.

The **COMMISSIONER** said he had seen the pawls mentioned by Mr. Milne, and both Captain Vetch and he were astonished to see them lying useless on the ground. He must say, whoever were the proprietors, that the pawls might have been allowed to remain. They would have been of great advantage to the shipping and to fishermen; and such conduct was no encouragement to the trustees to make any improvement. The document which had been given in would be carefully considered.

Mr. **ALLARDICE** stated that of late the mail had been several times detained, at one time upwards of three hours, from there being no low-water pier at the Dundee side of the river, which any vessel could approach with safety in a gale of wind. He was of opinion that a chain bridge should be erected from the land to the Beacon Rock, while erections might be made that would accommodate steamers and every other description of vessels at all times of the tide. (See App. No. 156.)

[Many of the most experienced seamen disapproved of this proposal, as it would shut up the present passage for vessels inside the Beacon Rock, and they were of opinion that this would render it a perpetual nuisance, whereas it and all the rocks in its neighbourhood ought to be removed in order to facilitate the entrance to the harbour in all states of the wind.]

Mr. **MURRAY** contended that the present low-water pier had fully answered the purpose for which it was intended, and that during the past summer it had been of the greatest advantage to the Leith steamer, and had often enabled her to get on board cargoes which she could not otherwise have done.

Mr. **CRIGHTON**, Lloyd's Agent, said the Beacon and Fowler rocks were the greatest impediments to the shipping in entering the harbour. Ships were very often damaged in consequence of them, and they should be taken out of the way altogether.

Mr. **CLARK**, shipowner, said these rocks were the cause even of many accidents that happened in the harbour.

The **COMMISSIONER** asked if they would not, rather than have a low-water pier to these rocks, as had been proposed, spend a few hundred pounds in blasting them away.

Mr. **PETER KERR**, shipbroker, said the trustees had taken power to borrow money and to erect a low-water pier. The time had all but expired when they put up the present trumpery erection in order to retain the power.

Mr. **CRIGHTON** had a great objection to a low-water pier at the Beacon. There was no connexion between King William's Dock and the Victoria Dock at present. If they were to erect a low-water pier there, vessels coming from the one to the other, as they often did in half ballast, would require to go out near to the middle of the river, which would be very dangerous. At the present time they could keep vessels close to the wall, and tow them down. There might be a suspension bridge but for the docks.

Mr. **KERR** had no doubt there would yet be a connexion between Victoria Dock and King William's Dock. It would be a great convenience.

Mr. **NEISH** said, from all his experience about the harbour, and he had been a shipowner for 25 years and a harbour trustee for 14 years, he was convinced that there could be no greater inconvenience and obstruction to the Harbour of Dundee than a low-water pier to the Beacon Rock. He hoped that such a thing would never be seriously entertained. He had seen 20 or 30 vessels going down the inside channel when they could have got out by no other way in consequence of the lightness of the winds.

Mr. **DAVID BAXTER** said it would save the time of the meeting if he stated that the power of the trustees to construct that pier had ceased, and no other party could do it.

Bailie **MOYES** said the clause in reference to the low-water pier was put in by the Government, principally at the instigation of Mr. Hume, he believed. The trustees would have had to have gone to Parliament for additional power to borrow money if they had carried it out. The wooden pier had no connexion with the other. It had been put up principally at the pressing request of Mr. Greig, of the *Britannia* steamer.

Mr. **ROBERTSON** stated that the dues had not much increased in consequence of the erection of the wooden pier, but the accommodation had been increased, and the *Britannia* had been enabled to ship more goods and cattle than she could otherwise have done. She sailed from it a certain number of voyages every month.

The **COMMISSIONER** said he had just received a letter from Mr. John Sturrock in reference to the defenceless state of the entrance of the river Tay. It did not come under consideration just now, but he would take care that the letter should be referred to the proper quarter. (See App. No. 153.)

Mr. **HUNTER**, to show the necessity of a floating-light, read a report of the wreck of the schooner *William* of Newcastle on the Abertay Sands; in which it was stated that the vessel had run on till on sounding they had just four fathoms water, and that then the Buddonness Lights could not be seen in consequence of thick weather, and shortly afterwards the vessel was wrecked.

The **COMMISSIONER** pointed out some discrepancies in the report, but expressed his satisfaction with the attention which was paid to this subject. As it appeared on all hands that the chief wrecks occurred during foggy weather, when a light would be of little or no use, he was of opinion that a bell-buoy, as at Liverpool, would be preferable to a floating light.

Mr. **HUNTER** said he had been led to give some attention to this subject by motives of humanity, and from the circumstance that he resided within a few miles of the mouth of the river. He did not see how a bell could be heard in stormy weather. A floating light he looked upon as neither more nor less than a light buoy, and he believed it would be of great service to the navigation. The Mersey at one time was as ill off as the Tay, but what had the people of Liverpool done? They applied to the Admiralty and got Captain Denham, a Royal Marine surveyor, and he placed three floating lights and sixty-four buoys. Since then not a single shipwreck had taken place.

The **COMMISSIONER**.—Mr. Hunter is quite right as to the admirable buoying and lighting of the Mersey by Captain Denham, R.N., but I cannot add that since then no wreck has taken place.

Mr. **HUNTER**.—There were six fixed and three floating lights now in the Mersey, and there was no talk of confusion; but at Liverpool they had no fraternity, and their light dues were managed

APPENDIX C.

DUNDEE.

No. 132.
Evidence taken on the 2nd Oct., 1846.

by responsible bodies, and merged in the general dues of the port. He had no ill-will to the Seaman's Fraternity, but it was to be remarked that that body derived 1800*l.* a-year from the lights, and only expended 700*l.* He held that it was illegal to expend the light money upon other purposes. Witness concluded by laying before the Commissioners the report which he had prepared for the Harbour Board, but which he could not succeed in getting the Committee to meet for the purpose of considering.

The COMMISSIONER was happy to receive the report. The subject was one of vital importance, and the community were deeply indebted to Mr. Hunter for his services.

Mr. JOHN JACK, harbour-master, examined—Has been 10½ years harbour-master and deputy-harbour-master in Dundee; was 30 years at sea, and during all that time he has been acquainted with the port of Dundee. Since he remembers, the traffic has increased very much indeed, which he attributes principally to the great increase of accommodation. In the mean time the accommodation is sufficient for the traffic; but in severe weather from the eastward, the docks are nearly all full. He has seen from 200 to 300 sail altogether in the docks. In the inside there is a tendency to silt; in the tide harbour it is from two to three feet a-year. The dredging keeps this down. The extreme point of the Ferry Harbour projects farther out than the harbour works, and this does injury to the tide harbour mouth. It would be a great advantage if the quays were straight, still they would have silt, as mud flows in with the tide; but if the quays were straight, it would be an advantage for the current. There was often difficulty in taking the harbour in consequence of the Beacon and Fowler Rocks. They had often their work to begin when they should be shutting the gates. Vessels could not get out. He believed that the subject had been discussed at the Harbour Board.

Mr. MILNE.—There is no minute to that effect. There may have been casual remarks.

COMMISSIONER.—It would be satisfactory if the trustees would make up their minds as to what is the best plan to be adopted with these rocks. If the expense of removing them is the obstacle, that should be the answer.

Mr. JACK.—It would be very desirable to have them taken down to low-water mark. A chain-pier would be still worse than the rocks. All ships transported from the one dock to the other track or tow down the inside channel. Vessels beating up for the harbour with a northerly wind take the inside. Has heard a great want of a low-water pier expressed, but is not an engineer, and cannot point out a spot for erecting one. Mr. Greig, of the *Britannia* steamer has derived considerable benefit from the wooden low-water pier this season. Many carriages have been landed, which could not have been done otherwise at the time. Is not aware of it silting up at the bottom of that timber pier. It is all mud there, and this season the dredging-machine was employed some time in making a good channel for the steamer. It dredged about two feet of mud from the foot of it. The steamer draws about seven feet, but there is a long flat, and the dredger would require to go a great distance. The flood tide does not sweep past. It runs away more to the offing, but the ebb runs more along The eddy caused by the Fowler and Beacon Rocks is very considerable. The channel could be dredged up, but it would require dredging to be kept open. There are depute harbour-masters, one for each dock. There is a good deal of damage done sometimes in the tide harbour from the press of sail coming in and crossing it. The rocks are partly the cause of that; if they were away, it would be much safer taking the harbour. He could not say there was great damage, but a spar carried away, or a ship's head injured, or an anchor going through the bottom. There are plenty of ship-yards in the town, which are well employed. There are thirteen building-slips, one graving-dock, one patent slip, and two floating-docks. There were 4314 arrivals from May 1845 to May 1846. The port is not well supplied with water, but an abundant supply is expected soon from Monikie, about eight miles from Dundee. All other supplies may be obtained. Any repairs can be made on steamers and other vessels. There are numerous cranes, and an excellent working thirty-ton crane. Knows the buoys and lights well, and does not think there are any lights wanted at the mouth of the river. The report about the loss of the schooner *William* at the mouth of the river, which has been mentioned, is a very poor report. No man in his sound senses would be guilty of the conduct there described.

The COMMISSIONER observed that he held in his hand a list of 27 vessels wrecked since the year 1828.

Mr. JACK.—When it is taken into account that there are from 4000 to 5000 vessels entering the river, and from 4000 to 5000 leaving it every year, the casualties will appear very few indeed. He is of opinion that there is no want of a floating light. Is not aware what the opinion of his predecessor, Lieut. Smart, R.N., was. No vessel has been ashore within these six months. There is hardly an instance of a ship getting on shore with a pilot on board. The want of pilots is the cause of many of the accidents. Is not pilot-master, but has to do with giving pilots certificates as a member of the Trinity House. Vessels are not bound to take pilots Pilots go outside if the weather is fine. Attributes a great number of the accidents that happen to the thickness of the weather. If there were a regular pilot-cutter, there would be far less. It should be compulsory on vessels to take pilots. The rates of pilotage are about 3*s.* per foot from the bar, including pilotage into the harbour. The pilotage might be lower if all paid; but there is no power to compel vessels to take pilots. The shipowners are the parties who object to pilots.

COMMISSIONER—Do the shipowners ever go to sea themselves?

Mr. JACK.—No; if they did they would know the benefit of a pilot on taking a harbour in a gale of wind. Mr. Stevenson, engineer to the Northern Lights, comes here. He goes out and comes in at the mouth of the river, and goes on shore at the light stations. The Trinity Yacht of London does not come in. She was expected last year. As an old sailor, and having had long experience of the river Tay and the banks, and the number of wrecks, he did not think that a floating light at the entrance of the river would be of service; vessels had the Firth of Forth as a harbour of refuge, and there could not be better. A light to bring them here might be an inducement to lead them away from that quarter; and if this were the case they must go on the banks. He is a member of the Seaman's Fraternity, who are very short of funds. They put down four buoys last year; and they put down a Fairway buoy at the entrance of the Tay, which stands fifteen feet above water, and which can be seen at ten miles' distance.

COMMISSIONER.—I know it well, and an admirable buoy it is.

Mr. JACK.—The sailors are very well satisfied. If they cannot find that, they cannot find anything. When he was a boy there was only one buoy in all the Tay. It is fully buoyed now. He had heard it stated to day that the banks were extending down the river, but he knew no difference this long time. The Ballast Bank, he thought, was going off shore very fast.

APPENDIX C.

DUNDEE.

No. 132.
Evidence taken on the 2nd Oct., 1846.

Examined by Mr. HUNTER.—The report of the loss of the *William* was a very foolish report. It was not drawn up by Lieut. Smart. He only transmitted it, He was not aware that some of the oldest pilots were in favour of a floating light. Never heard any complaint except from Mr. Hunter himself. David Kidd knew nothing more about the Middle Bank than his stick.

Mr. NEISH said, Mr. Jack has told us that David Kidd knows no more than his stick of the state of the Middle Bank. It was somewhat strange that Mr. Jack should say that, who was a party to the licensing of him It was not long ago since, by the ignorance of the pilot, a valuable ship was put ashore The men are licensed to bring ships up.

COMMISSIONER.—A sea pilot may not know every bank in the upper part of the river, but unquestionably he should know the Middle Bank; and should be able to handle a square-rigged vessel.

Mr. KENNEDY.—There was a complaint lodged against the pilot; and on inquiry it was learned that the vessel was a new one, and wanting to show off. He agreed with the Commissioner as to the qualifications which pilots should possess, but it was impossible to get them with such knowledge. The fraternity could not place a floating light without imposing new dues. It would cost about 1200*l*. a-year.

Mr. HUNTER.—The Nore Light costs only 506*l*.

COMMISSIONER.—The Nore Light vessel lies in smooth water, but I think she costs more than that.

Mr. CRIGHTON was not connected with the Seaman's Fraternity, but he did not think a floating light would be of any use. If the weather was clear, they had the Bell Rock and the Lights of May; and they must be very stupid men if they cannot see the leading lights in Tay. The Fairway buoy may be seen at a distance of from 10 to 12 miles. He could see it from his window with a glass on a clear day. He did not think a floating light would be of any use in clear weather, and in thick weather it would be useless. In a swell with light winds a bell must indicate the position certainly better than a floating light. He had no hesitation in saying that if the lead was used, there would not be one-fourth of the accidents.

Mr. HUNTER enumerated the various rivers where floating lights were used, as the Thames, Humber, Tees, &c., and concluded by saying that he was not satisfied with the management of the Seaman's Fraternity.

Mr. CLARK, shipowner, was of opinion that a floating light in the inside of the bar at No. 3 buoy would be of great service It was after they entered the river that the greatest number of accidents occurred. He once very nearly lost his life on board of a vessel which was wrecked after she had fairly entered the Tay; and if there had been a floating light where he pointed out, that accident would not have happened.

Mr. KENNEDY read an extract from a Report by Mr. Stevenson, engineer, on this subject:—

"The Frith and River of Tay are fortunately so situated as to have guide lights upon *terra firma*, an advantage which favourably distinguishes it from the Humber, the Thames, the Mersey, and the Liffey; the distant and tortuous nature of the sand banks and channels of these navigable tracks render it impossible to have lights upon the shore answerable to their respective navigations, and therefore recourse must be had to floating lights. But in the navigation of the Tay there is no need to resort to a light afloat, because the two sets of leading lights ashore perfectly answer all the purposes of this estuary, while an additional light would assuredly tend to confusion among the existing lights of the district. Under these circumstances, it is surely unnecessary to create an additional burden upon the trade of the Tay of not less than 1200*l*. per annum, which is the average cost of maintaining the floating lights on the coast of England. I am of opinion, that much more benefit would be derived by the shipping interests of the Tay, by organizing a better system of pilotage, placed under the Trinity House of Dundee; and, if possible, to induce mariners bound for the Tay in a foggy and tempestuous state of the weather to make for the Frith of Forth, and wait a favourable change for entering the Tay. If these two points of pilotage and caution were attended to, I am confident that few accidents of shipwreck could occur at the entrance of the Tay."

Mr HUNTER would have been quite satisfied if the report had been from Captain Denham, R.N., or anybody but their own engineer. He read from the evidence of Mr. Alan Stevenson before the House of Commons, to show that his opinion, although he had not fully considered the subject, was more favourable to a floating light than his father's.

Mr. CRIGHTON said, if a vessel were to see the floating light over the Gaa Sand, it would be for making straight to it. If a floating light is placed, sailors will be sure to steer for it; but if sand intervene, what will be the result if the light is seen at all. It will form a prominent object from Buddonness to Buoy of Tay, and sailors will steer for it.

Mr. KENNEDY.—In case of foggy weather he could anchor off the Buddonness Lights. He would not anchor there if he could help it. He would rather anchor at the Lady. It would be very thick if he could not grope his way up.

DAVID KIDD.—Has been 37 years a pilot, and acquainted with the river from his youth. Has brought a very great many ships into the river. He has boarded ships at the Bell Rock, at St. Andrews and 20 miles out. Never run any ashore. Steers by his compass from where he picks up his ship The lead will lead him up to the bar if the buoy cannot be seen. The soundings gradually decrease at the bar. At the buoy there is 17¾ feet at low water. He has brought a thousand sail in in thick weather, when he could not see the lights. There should have been a floating light 20 years ago at the Elbow Buoy, No. 3. When out in a dark night, where can a man look for a buoy? and if a hoar frost sets in upon the land, the lights are not to be seen. He was not afraid of living in the floating light, and would have no objection to do so for the first five years. It would be a great benefit to the Seaman's Fraternity, and should be seconded by Mr. Kennedy. Has taken 60 men, masters and seamen, off that bank, and saved them from a watery grave—among others Captain Clark, pointing to that gentleman. The great danger is after you enter the river if there is an ebb tide. Has known the banks from his infancy upwards. He can take a ship through various swatch-ways in the sands, and nobody on the river can do that but himself. Could guide a ship in half the breadth of this room. The banks are always altering. He always kept his lead going from the Bell Rock, and so do other pilots. There is as much water over the Gaa on the inside as over the bar of Tay. At low-water spring tides there is 21 feet. There are two channels for Tay. He could go away a mile from that, and still have deep water.

Mr. JACK said it was only twelve months since the pilots were examined, and they had no leads or lines in their boats.

APPENDIX C.

DUNDEE.

No. 132.

Evidence taken on the 2nd Oct., 1846.

COMMISSIONER.—Such a fact is calculated to make the other parts of Kidd's evidence appear doubtful

CAPTAIN SPINK of the London Shipping Company, has been 40 years acquainted with the Tay. Did not think a floating light would be of service. Is a member of the Trinity House, but that did not prejudice his opinion. He thought a light-vessel would be more apt to lead vessels into danger than to do any good. Would prefer leading lights to a compass course. A bell-buoy might be of some use in thick weather. He had been several times kept out of the river from hazy weather. This very morning he was kept out for an hour, and a floating light might have been the very means of bringing him into danger. Iron ships are coming into use, and they cannot sail by the compass within three or four points. He believed the wreck of the *Great Britain* was principally to be ascribed to this. He was aware there was a bell-buoy on the Mersey, and that it was of great use there. In regard to the Tay, he had nothing to suggest, he thought it was sufficiently buoyed and lighted. It had been improved. Large buoys had been put down in several places, and these had been found very useful. There is a capital buoy here, as good as any he had seen. Pilotage should be compulsory. There should be no exceptions The London Shipping Company had no protection from light dues, and willingly paid them. A floating-light could not be placed without fresh dues. It would lead to confusion.

Examined by MR. HUNTER.—Knows that there are six or seven floating lights between the Nore and the Cork light off Harwich, a distance of 40 miles. In some parts an additional light would lead to confusion. Could not give any instance of a floating light leading to confusion; but thinks that an additional light at the entrance of the Tay would do so. In the event of thick weather, it would be of no use; and in clear weather, the lights of Tay are sufficient. In the event of even seeing that single light, no sailor would like to guide his ship by a compass bearing. Was aware that it was difficult, or hardly possible, to go through the Swin channel at the entrance of the Thames by night until two or three additional lights were placed there. These did not lead to confusion though they were within a few miles of each other, in one case within 2½ miles.

MR. HUNTER read the evidence of Mr. Marshall, manager of the London Shipping Company, before the House of Commons, to show that that gentleman considered the light dues oppressive, and that were they lower, an additional voyage a-week would be made by the Company's steamers.

Captain SPINK was convinced that the light dues had no effect on the number of their voyages. The Company were aware of the value of the lights, and did not grudge to pay for them.

COMMISSIONER.—Are you one of those who attended the Royal Squadron? Were not the lights of use on that occasion? And was not the *Royal Yacht* with the whole of the squadron, brought up the Tay in the middle of the night, and anchored in safety in the Queen's-road off Dundee?

Captain SPINK.—I am. The lights were of great service.

MR. B. IRWIN of the Coast Guard.—There is landing accommodation for ships at Broughty Ferry, in the bay near the wooden jetty, which is almost useless. It is for the accommodation of the Perth steamers. The pilots frequently come under my notice. When there is a storm from the east, they generally board ships about Broughty Castle.

COMMISSIONER.—Are you quite certain of that point, and that they do not board them outside the banks.

MR. IRWIN.—Yes. Has heard what the pilot Kidd said. He might have boarded ships far out occasionally, but the usual place to board vessels is about Broughty Ferry. When it blows a storm, vessels seldom or never have a pilot. There is no compulsion to take pilots, and therefore they think it as well to board there. He knew an instance last week where a pilot boarded on the outside of the river, and the master of the vessel refused to give any more than harbour pilotage. He does not think vessels should be allowed to come up without pilots. It is at the great risk of property. Pilotage should be compulsory, and there should be decked boats. There should be two decked boats when the wind is easterly. Some of the pilots are efficient men, but did not think they were generally properly qualified. They knew the river well enough, but they cannot handle a vessel. They should be able to do that. They should be a distinct class by themselves, dependent on nothing but pilotage. The trade of this port should be sufficient to maintain a regular set of pilots, and in this case the rate might be lowered. If this were done there would be fewer casualties. Sometimes the lights cannot be seen, and vessels run in, trusting to their soundings. He knew one vessel which lately came in over the Gaa Sands, where there was only fourteen feet of water. Does not think a floating light would be of any use. The lights of Tay are sufficient. All that is wanted when it is thick weather is a pilot to help vessels in. Thinks a bell-buoy would be of use in hazy weather; but it is only in hazy weather that anything is required. The Fairway Buoy is a fine, large conspicuous buoy. Knows nothing of the sands up above Dundee. Thinks it would be an improvement if an alteration was made on the lights at the South Ferry. The new gas-lights are so bright that they are apt to be mistaken for them, and it might be better if one of them was a red light.

Captain KIDD, of the London Shipping Company, has been thirty years acquainted with the port. A floating light would only cause confusion. A bell-buoy might be of use, but does not think it would be heard half a mile off in a gale of wind. In fogs and calms it might be of use. Knows very well about the pilots. Has seen them on the other side of the buoy, but never saw them engaged in sounding. The fishing boats cannot go through any sea. A floating light in the inside of the river would be an obstruction. It would make more confusion than it would do good. Does not think the lights could be better.

MR. LANCEMAN WEBSTER has been three years pilot-master, has been about forty years at sea, twenty-eight of which was a shipmaster. Has twenty-eight pilots under his orders. They are regularly examined by the Seaman's Fraternity as to the depths of water, &c. Complaints of the pilots have frequently come in to him. Has known pilots board outside, near the Bell Rock. The pilots go outside in winter, but they cannot remain out. A pilot cannot earn his bread by his business. Does not think pilotage should be compulsory. Knows it is compulsory in the Thames, the Mersey, and the Clyde. There is no want of a floating light. Has frequently heard the subject discussed by sailors, and that is the general opinion. A bell-buoy could not be heard far in foggy weather, especially in the neighbourhood of breakers on the banks, and would be of no great use. Is a member of the Seaman's Fraternity.

MR. JOHN KENNEDY is master of the Trinity House. All the beacons, buoys, and lights are under the superintendence of the incorporation. No complaints have been made of the lights or light dues, with the exception of the master of the Leith steamer. The provost had mentioned to-day that that

APPENDIX C.

DUNDEE.

No. 132.
Evidence taken on the 2nd Oct., 1846.

gentleman had spoken to him in favour of a floating light. He was very much surprised at this statement, as Captain Greig stated, in a petition for a reduction of his light dues, that he did not require the lights at all. Vessels sometimes get on the Carr Rock off Fifeness. Thinks the beacon there is the same as it was several years ago. It is not under their charge. It is not near so conspicuous as the Fairway Buoy. The lead gives no warning. The Commissioners of the Northern Lights do not interfere with the Tay Lights, but he remembers their once inspecting them. They came here to consult about a leading light on the May in order to clear the Carr Rock. It never was suggested that one of the Ferry lights should be red. He is afraid it would lead to confusion with the Harbour Lights. Knows that at one time when the present red light on the Queen's Quay was a white one, the gas was so clear that it was mistaken for a Ferry one; and if they were to make a Ferry light red, confusion must arise. Many vessels came over the top of the Gaa Sands with these lights in one. They have three fathoms of water at the least. He was down with Captain Otter, R.N., last autumn, and there were about four fathoms at low-water spring tide. He can recollect of only seven or eight feet, or scarcely that. He recollects some old gentlemen going about who said it was very different from what it is now, as they had seen it dry where there are now three fathoms water. The largest war-steamers could come safely into the river, and get good anchorage. He could bring in a two-decked vessel if there was a leading wind. The Buddonness Lights were erected about 1609. The old lights were not in the same line with those at present. They were farther east.

Mr. ALEXANDER MARTIN.—At one time the river flowed out with Broughty Castle and Dundee Law in one; that is a well-ascertained fact. It now comes back towards the old mark.

Mr. KENNEDY.—The Horse-shoe Shoal is not a great annoyance. Heard the discussion to-day about a floating light. It had been frequently and fully considered by the incorporation, who were quite willing to grant it if considered necessary. The income of the incorporation from Christmas, 1844, to Christmas, 1845, was 1842*l.* 12*s.* 6*d.*; and the expenditure on lights and buoys, 1,085*l.* 13*s.* 1*d.* The rest was bestowed in pensions to widows of poor members. The income is not nearly all derived from light dues, there being property, entries, and dues paid by members. The expenditure on lights will be a good deal more this year. There are 154 paying members. A committee of twelve manage the business; and their services are gratuitous, with the exception of the master, who, from old use and wont, receives a sum of two guineas yearly. Were their services not gratuitous there would be no surplus. There are general meetings quarterly, and committee meetings as required by the business. They have nothing to do with the buoys off the harbour of Dundee or the buoys up the river. He would strongly recommend a proper pilot establishment. Some years ago he made a statement at the Harbour Board, in which he showed that if a proper pilot establishment were got up, and pilotage made compulsory on all vessels above one hundred tons and on all foreign vessels, there would have been sufficient dues to remunerate the pilots, and leave a surplus of 100*l.* a-year. He would forward a copy of the statement referred to to the Commissioner. In bad weather it is well known that pilots cannot possibly go out to sea in open boats. The Broughty Ferry fishermen sometimes board vessels a good way off, but they will not go to fish in bad weather. There should be a decked vessel. There have been some meetings upon the subject, and it was said that the London Shipping Company objected very much to compulsory pilotage, as their masters knew the river so well; but private interests would have to be given up for the public good.

COMMISSIONER.—Mr. Kennedy, I have much pleasure in saying to you, as I have said before, that the Tay is as well buoyed and lighted as any river in her Majesty's dominions. I have seen the new Fairway Buoy, and a better buoy I never saw; and heartily hope your good example in placing it may be followed elsewhere.

Mr. DAVIN BAXTER objected to Mr. Kennedy's plan of compulsory pilotage so far as it would exempt coasting vessels under one hundred tons, and charge pilotage dues on all vessels coming from foreign. These vessels were often Dundee vessels, regular traders, and their masters were quite capable of taking the river. He would make all vessels pay, laying on a certain uniform rate below a certain tonnage.

Mr. CRIGHTON said it was notorious that some improvement in the system of pilotage was required.

COMMISSIONER.—There is nothing to prevent your having good pilots. Pilotage should be made compulsory on all vessels above 80 tons. There are plenty of sailors in Dundee, and it rests with the Harbour Board to select well-qualified men, and to licence only them.

Mr. PETER KERR.—There is nothing to prevent us having good pilots if they were paid. Until to take a pilot is made compulsory, they would never be good. As an instance of how pilots were treated, he could state that if pilots went on board outside, masters would often say, "You can stop on board if you please, but you will only get harbour pilotage." If such a vessel was wrecked, there could not be a doubt that the master would assert there was a pilot on board.

Mr. CAIGHTON said the removal of the Beacon and Fowler Rocks would be a great advantage. They should be swept away. The river is very well buoyed and lighted.

COMMISSIONER.—I fully agree with you; those rocks at the very entrance of your harbour are an absolute nuisance, and should be quarried and blasted away, or got rid of at any cost.

Mr. PATRICK JUST said—There is a life-boat, which is kept up by a small tax on the shipping of the port. The boat is kept at the Buddon Light; but the crew have to be got from Broughty Ferry or East Haven. There is great difficulty in getting her sent out. When the crew is sent for and not required, gratuities of two or three shillings each are given to the men. If their services are necessary, they get one, two, or three guineas, according to circumstances.

Mr. IRWIN.—There is a very small remuneration to the crew. He has had occasion to get her manned, and the remuneration was very small. They did not get half what they should have got. Some regulations have to be complied with. The boat is very heavy, and a bad sea boat. He believes she was built by subscription.

Mr. JUST.—The Committee have under consideration the building of a new boat. He was at Shields this season, and went on to Sunderland, and so obtained from these places a model of a life-boat, with the latest improvements of Mr. Orton.

COMMISSIONER.—There is another by Mr. Bremner, of Wick, which moves with paddles wrought by a crank, and is said to do more work than can be done by any oars. When such a small sum as 150*l.* would get a most efficient life-boat, the port of Dundee should not be without one.

Mr. CRIGHTON.—The difficulty is not so much the boat as getting her manned.

COMMISSIONER.—Could not fishermen be encouraged to settle down at the Lights near Buddonness.

No. 132.
Evidence taken on the 2nd Oct., 1846.

Mr. KENNEDY.—The beach is very flat for a great distance, and they cannot get their boats launched.

Mr. CRIGHTON.—If there was an efficient pilotage, there would not be much use for a life-boat.

Mr. JUST mentioned that there is also a small life-boat for taking off people in lighter weather, but it cannot go out in a heavy sea.

Mr. MARTIN explained that the life-boat is not of much use in this river. It cannot go out from the beach. They have to go round the bank with it, and then down to the ship. Were it to lie at Broughty Ferry, the crew could not take it down in the face of an easterly wind.

In answer to a question from the Commissioner, Mr. Kennedy explained that the Trinity House had been some time ago appointed a board of examiners of masters and mates in the merchant service, by the Lords of her Majesty's Privy Council for Trade. About twenty or twenty-five had been examined. It is not compulsory.

The COMMISSIONER thought the examination should be generally supported, and he had no doubt it would yet be made compulsory. He hoped the port of Dundee would go on advancing, but this was only to be done by making the most of the benefits which nature had bestowed upon her; by jealously guarding their noble river from encroachments; by giving facilities to trade and passengers by the erection of a low-water pier; by establishing an efficient body of properly paid pilots, and especially by removing the rocks, which not only obstruct the passage of vessels in and out of the harbour, but cause still water, and a consequent deposit of silt, exactly at the harbour's mouth.

(*Adjourned.*)

No. 133.

Return to Order of the House of Commons of 9th August, 1844.

No. 133.
Return to Order of the House of Commons of 9th Aug., 1844.

Dundee, April 5, 1845.

IN compliance with the order of the House of Commons of the 9th of August, 1844, the Clerk to the Trustees of the Harbour of Dundee begs leave humbly to submit the following Return:—

I. Titles of the several Acts of Parliament under which the Trustees of the Harbour of Dundee have acted, and now act; that is to say,—

55 Georgii III. cap. 97.

1st. "An Act for improving the Harbour of Dundee, in the county of Forfar."

59 Georgii III. cap. 103.

2nd. "An Act to alter and amend an Act passed in the fifty-fifth year of his present Majesty, for improving the Harbour of Dundee, in the county of Forfar." (14th of June, 1819.)

11 Georgii IV. cap. 119.

3rd. "An Act for more effectually maintaining, improving, and extending the Harbour of Dundee, in the county of Forfar." (17th June, 1830.)

Note. This Act repealed the Acts Nos. 1 and 2, and constituted a permanent trust for the management and extension of the harbour. In virtue of the provisions of this Act, the corporation of the burgh of Dundee transferred, on compensation, the harbour and works to the Parliamentary Trustees, conform to an instrument or disposition, of which a printed copy is herewith transmitted (No. 27). The principal deed has been deposited in the Register-office at Edinburgh for preservation.

6 Gulielmi IV. cap. 61.

4th. "An Act to alter, amend, and extend the Powers of an Act passed in the eleventh year of His late Majesty for more effectually maintaining, improving, and extending the Harbour of Dundee, in the county of Forfar." (7th June, 1836.)

6 et 7 Victoriæ, cap. 83.

5th. "An Act for altering and amending the Dundee Harbour Acts; and for more effectually maintaining, improving, and extending the Harbour of Dundee; and for other purposes connected therewith." (28th July, 1843.)

II. Copies of Reports, &c., made by Engineers, or other officers or persons, respecting the Port or Harbour, sent herewith.

1st. Report of John Smeaton, Engineer, upon the harbour of Dundee, 15th March, 1770.

2nd. Report of Robert Stevenson, Esq., Civil Engineer, relative to the improvements of the harbour of Dundee, 2nd February, 1814.

3rd. Account of the works of Dundee Harbour, by Thomas Telford, Esq., from his published works.

4th. Report to the Provost and Magistrates and Harbour Commissioners of Dundee, respecting the extension of the docks, by James Jardine, Civil Engineer, 1st February, 1830.

5th. Report, by John Gibb, Esq., Aberdeen, on the harbour of Dundee, May, 1831.

6th. Report, by the said John Gibb, Esq., on the harbour of Dundee, dated 29th February, 1832.

7th. Report, by James Leslie, Esq., Engineer of the harbour of Dundee, relative to the proposed harbour or jetty at Broughty Ferry, dated 25th December, 1835.

8th. Account of Dundee Harbour, and of the progress of its Improvements, prepared for the Institution of Civil Engineers, at the request of the President, by the said James Leslie, Cor. M. Inst. C.E., Engineer of the Works, December, 1838.

III. (1.) Copies of Complaints made to the Trustees of the Harbour of Dundee.

9th. Letter from Mr. James Kennedy to the Clerk to the Trustees, dated 27th December, 1844, complaining of want of low-water pier.

10th. Report, by Mr. Leslie, the Harbour Engineer, on the above letter, dated 10th March, 1845.

APPENDIX C.

DUNDEE.

No. 133.
Return to Order of the House of Commons 9th Aug, 1844.

11th. Excerpt from Minutes of the Committee on Works of the Trustees of the Harbour of Dundee, dated 13th, and approved of at an Adjourned Stated General Meeting of said Trustees, held 17th March, 1845, in relation to Mr. Leslie's Report. (No. 10.)

III. (2.) Copies of Complaints, by the Trustees, of encroachments upon the privileges of the Harbour.

North or Forfarshire side of the Tay.

12th. Minute of the Committee of the Trustees of the Harbour, complaining of the rights of the Harbour Trustees, in relation to the beach at Broughty Ferry, being infringed upon, and directing legal proceedings, dated 3rd April, 1839.

13th. Copy Record in the action of Declarator at the instance of the Trustees against David Hunter, of Broughty Ferry.

14th. Report, by the said James Leslie, Esq., on the operations of Lord Kinnaird and other proprietors on the bed of the river Tay, dated 22nd September, 1843.

15th. Report, by the said James Leslie, Esq., on the same subject, dated 16th October, 1843.

16th. Further Statement, by the said James Leslie, Esq., prepared to be submitted to Council, dated 24th October, 1843.

17th. Copy Schedule of Protest served upon Lord Kinnaird, &c., 10th February, 1844.

18th. Excerpt from Minutes of Adjourned Stated General Meeting, containing instructions to Mr. Walker to report, 27th May, 1844.

19th. Minute of the Committee on Rights, containing specific instructions to Mr. Walker, 13th December, 1844.

20th. Excerpt from Minute of General Meeting, approving of Minute of Committee, with an Amendment, 16th December, 1844.

21st. Report of James Walker, Esq., on the operations of Lord Kinnaird and other proprietors on the bed of the River Tay, dated 21st January, 1845.

South or Fifeshire side of the Tay.

22nd. Copy Minute of the Harbour Trustees, as to Dike at South Ferry, 6th May, 1844.

23rd. Report by Mr. Leslie, as to ditto, 17th May, 1844.

24th. Copy Minute of Special General Meeting of Trustees as to Prince of Wales, 4th June, 1844.

25th. Copy Queries to Memorial for Opinion of Council. Answer or Opinion annexed to each Query.

26th. Printed Copy Summons of Declarator, the Harbour Trustees against William Stark Dougall, of Scotscraig, and others, 2nd August, 1844.

27th. Printed Copy Disposition by the Magistrates and Town Council of Dundee, in favour of the Trustees of the Harbour of Dundee, dated 13th April, 1841.

IV. Copies of Maps of the Harbours sent herewith:—

No. 1. Chart of the Tay. (This chart is referred to in Mr. Walker's report, and the particulars of the survey directed by him are marked upon it.)

No. 2. Crawford's plan of Dundee.

No. 3. Mr. Telford's plan as adopted, 1814.

No. 8. Parliamentary plan of 1829.

No. 9. Plan of 1830, as when the Act (11 Geo. IV. c. 119) was passed.

No. 16. Plan of Harbour, 1836.

No. 22. Plan of present state of works.

No. 23. Parliamentary plan of 1836.

(The above are referred to in Mr. Leslie's account of Dundee Harbour.)

No. 31. Plan of the proposed enlargement of Dundee Harbour, by Robert Stevenson, Esq., in 1814.

No. 32. Parliamentary Plan of Dundee Harbour of 1842. (Not adopted by Parliament.)

Nos. 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 24, 25, 26, 27, 28, 29, 30, relate to matters of detail, and are not sent.

GEO. MILNE,
Clerk to the Trustees of the Harbour of Dundee.

The Hon. H. Manners Sutton,
&c. &c.

No. 134.

Report of JOHN SMEATON, Esq. C. E., *on the State of the Harbour of Dundee.*

No. 134.
Smeaton, on improving the Harbour.

Austhorpe, March 15, 1770.

IT is a very difficult thing to make an artificial harbour to be in all respects complete; for the very means that tend to render it safe and quiet for vessels tend to make it less easy of access, and more subject to mud, silt, or sand, such as the coast happens to be annoyed with. The harbour of Dundee, by being too much enclosed, is too subject to mud, and in such a degree as greatly to diminish the space enclosed, especially for larger vessels. I observe that the places where the mud chiefly lies are at A and B, which are several feet higher than the entries and spaces near the runs of the sluices, particularly that at B. The present means of clearing it are by drawing a complete quantity of water from one or other of the sluices upon the basin at C or D, and by a number of men set to confine the current into a channel at pleasure, and throwing in the mud, whereby it is carried without the entries, and thence taken away by the run of the tides. This operation, it is said, answers

Appendix C.

Dundee.

No. 134.
Smeaton, on improving the Harbour.

pretty well as to clearing the harbour, but it is attended with considerable expense, and requires to be often repeated. Notwithstanding what assistance can be given by running the sluices, when unassisted by men at the bottom, it is said, that before the pier E was projected so far, and before the ground was made up at F between the little bay G and the harbour, that it was then less subject to mud, particularly at B, and indeed this very well corresponds with the reason of the thing; for I observed when there, the 4th of August, 1769, being the third day after new moon, and consequently at the height of spring tides, that on tide of ebb a very strong current set past the end of the pier E and was diverted thereby from the harbour mouth; of consequence, were there proper openings made in the neck at F, though they cannot be expected to clear away the mud at B already deposited, yet, being once done by other ways, this will be the most likely means of keeping it clear; I would therefore recommend that this neck be pierced by two sets of tunnels, in the directions shown at F, three and three together, of 12 feet wide each. They may be arched over so as to make good the platform at top, or, by way of saving arching, may be shortened according to the dotted line at F. These tunnels should be made with a clear passage as low as they can be made for the rocks, or to low-water mark. The cross wall H I, instead of being carried from H to I, must be turned round at L, so as to leave open the space M of its natural depth. That the tunnels may be freely supplied, the present little pier, shown by dotted lines at N, should be totally removed, and the rock at O should be levelled with the rest surrounding it, and the whole so reduced as to give all freedom of waterway possible through the tunnels; and in this state of things, if the pier E had occasion to be carried out still further, it would bring the tide more forcibly through the tunnels.

The means above mentioned, by promoting a more free circulation of water through the harbour, would tend to keep down the bank of mud at A, but I cannot think it would effectually keep it clear; but I apprehend when this is once done, by the help of men as before, by a more judicious disposition and application of sluices upon the present basin, the whole harbour may be kept in a great measure free. In the first place, I apprehend the waterways of the sluices are much too small, for, though the basin itself is much smaller than were to be wished, yet the letting the water go off in a small body, though continued a longer time, is not making the best use of it: a certain power of water will move that very expeditiously, which applied in a less degree will let the subject remain at rest; consequently the water, being discharged from the basin in a large body, will do that in five minutes which would remain undone if the capacity of the opening were reduced so as to play a quarter of an hour. For this reason I would advise the sluices to be full three feet square in the orifice, and to be laid rather lower than the bottom of the basin. The sluice D may still remain the place for one of them, but, instead of the sluice C, I would advise two upon that line at P and Q of the dimensions aforesaid: that at P will more directly tend to scour the face of the pier R than in its present position C; and also to keep down the growth of the mud at A, and more especially if a passage be first opened for it to vent its water by the opening S; but the sluice P being so much nearer the pier R, it will be so much farther from the east pier; to keep the face whereof clear, it will be proper to have the other sluice, mentioned at Q, which will also serve a secondary use; for as the basin itself is liable to fill with mud, which I suppose it is a considerable expense to remove, this may be prevented by building a cross wall, according to the dotted lines, with a sluice upon it at T, of equal size or rather larger than the others, constructed so as to pen the water either way. This sluice may therefore be made use of by penning the water in one half of the basin to scour the other, and so alternately; and when open, suffers the whole basin to act by any of the interior sluices. To avoid loss of water it will be proper to have all the sluices, particularly those at Q, P, and D, executed in the most substantial manner. I cannot advise the doors to be cut, in order to make a valve to let the water in, but rather to set one of them open by hand; and to prevent accidents by neglect, a small tunnel, with a valve in part to let in and effectually to keep in the water, may be fixed in the present opening at C. This I think will be the most effectual way of applying the water of the basin without the use of men, and I think it would also add, if to the opening in the east pier, which if I remember right is there already, there were another added not less than 25 feet wide, so that they may be nearly in the position V V. By these means I expect the harbour may, when once cleared, be kept clear, or so nearly so that, with a little help from men occasionally to direct the water to particular places, it may be effected in the most easy manner that the situation will admit of.

J. Smeaton.

N. B. To prevent loss of room in the basin by the cross wall, it may be a strong stone wall, well built with lime, and ashlered on the two outsides.

No. 135.

Report of Robert Stevenson, Esq., C. E., *relative to the Improvement of the Harbour of Dundee.*

No. 135.
Stevenson, on the improvement of the Harbour.

Edinburgh, February 2, 1814.

Gentlemen,

It is curious to observe the changes and to trace the progressive improvements which have taken place in the form and *build* of ships.

When we contrast those of early navigators with ships of modern times, among the many alterations none seems more striking than the difference of their depth or draught of water. What was formerly deemed a sufficient depth of water for a ship of 300 tons burden would hardly be found enough to float a modern-built vessel of 100 tons.

This alteration in the construction of ships, which is mainly calculated to improve their sailing, by giving them a better hold of the water, seems gradually to have advanced as the mariner became more adventurous is his voyages, and is only now restrained by certain considerations of conveniency, of which the most prominent is the want of a sufficient depth of water in the havens and harbours on the coast of their reception, a circumstance which arises partly from the natural position of harbours, but is chiefly owing to the difficulties and expense attending the necessary architectural operation, which increase in the ratio of the depth of water. Hence it is that many of the ancient seaport towns of this country, which at one time possessed an extensive trade, have, from neglecting their harbours, sunk into a state of insignificancy, while others, by proper exertions in this respect, have under the most inauspicious circumstances attained to great commercial importance.

The position of the harbour of Dundee, as delineated on the accompanying survey and plan, is on the north side of the river Tay, between Carolina Point to the eastward and the Magdalen Yard Point to the west. It may be noticed in a general way that the Tay, after passing through a considerable

APPENDIX C.

DUNDEE.

No. 135.
Stevenson, on the improvement of the Harbour.

tract of highland country, joins the Earn a few miles below Perth, flows gently through the Carse of Gowrie, begins to assume the character of a frith or arm of the sea near Dundee, and becomes more and more affected by the tides as it approaches the ocean. At the confluence of the Earn and Tay the river is about half a mile in breadth; at Invergowrie, above Dundee, it is upwards of three miles in breadth; and at Broughty Castle, below Dundee, it again contracts in width to about three-quarters of a mile. It therefore appears that in the neighbourhood of Dundee the Tay forms a great basin, and at high water an immense space of ground is covered, compared with the narrow passage or outlet just described. This basin, where the waters get nearly into a quiescent state, naturally becomes a depository for the sand and alluvial matters brought down the river on the one hand, and for those brought up by the tide from the sea on the other; and excepting the small part occupied by the bed or *alveus* of the river, this basin presents at low water one great *ebb*, consisting of extensive sandbanks, and bays covered with silt and mud, which line the shores of the Tay. Nor is this condition of things confined to the Frith of Tay; the very same appearances are to be found in the Frith of Forth, both above and below Queensferry; in the Murray Frith, above and below the narrow at Fort George; and in other analogous situations in different parts of the kingdom.

In describing the present state of the harbour of Dundee, it may again be noticed that, situated as it is on the side of an extensive basin encumbered with sandbanks and vast collections of *sleek* and mud, it cannot be supposed to remain free from these without some extraordinary preventive measures being resorted to. By inspecting the plan of the present piers, they will be found so irregular in position as not only to be highly inconvenient, but also to have a tendency to create eddies in the harbour, and thereby to increase its liability to fill up with silt or mud. Under these circumstances, whether this harbour be considered in regard to its depth of water for floating loaded ships, or in regard to its extent of quays for their berthage, it will be found extremely incommodious, and but ill adapted to the thriving and extensive trade of Dundee.

The reporter has had numerous opportunities of observing the set of the tides and currents in the Tay, from his intercourse with the works of the Bell Rock; and when called upon by the magistrates in November last to inquire into the condition and practicable improvement of the harbour of Dundee, he had ample opportunities of verifying his former observations, and of examining the facilities and likewise the disadvantages of this harbour during the spring tides of the 20th, 22nd, and 23rd of that month. He is now to inquire more particularly into the causes of the accumulating of silt in the bottom of the harbour, and the want of accommodation or berthage for shipping at the quays. He will then submit what appears to him to be the proper remedies for those evils.

First, then, with regard to the accumulation of silt, and the consequent inconveniences which attend the want of an equal depth of water in every part of the harbour.

In examining the waters of the Tay above Perth, and entirely beyond the influence of tides, they will be found in the ordinary state of the river to be pure and uncontaminated; but after passing Perth they enter upon the flat alluvial lands of the Carse of Gowrie, and come in contact with clayey matters, the finer parts of which are carried along with the stream, till the river becomes much expanded in breadth, when these matters are in a great measure deposited again; and in speats of the river the quantity of deposit is greatly increased by matter washed down from the upper parts of the country, as is evident from the shining micaceous particles visible in the silt then deposited. In the same manner, sandy particles are *borne* up the river by the tide with a great velocity till the waters expand in the basin of the Tay, when these particles get into the eddies of the current, and are deposited in the form of extensive sandbanks of various shapes, which are occasionally changing. From this state of things, it may readily be supposed that all the creeks and sinuosities along the margin of the river become so many receptacles for depositions of this kind, and that the harbour of Dundee must have an abundant share of them. It is accordingly obvious, on the slightest inspection of the harbour, that a considerable depth of water is lost by the sludgy mud which is left in it by the waters of the river; and from levels taken on the spot by the reporter, this deposition, which more or less covers the whole area of the harbour, appears to be no less than from 2 to 4 feet above the low-water mark of spring tides, and at some of the quays or berthing-places for ships the silt is about 6 feet in depth, or more than one-half of the rise of ordinary tides. It is a fact that, although there may be reckoned fully 3000 feet of quays at Dundee, yet, from the accumulation of sludge in the botton of the harbour, and the irregular construction of the greater part of the piers, there is not at this moment above 500 feet of berthage where vessels requiring the full rise of the tide to float them can be brought to load or discharge their cargoes. It therefore becomes a matter of the last importance to propose, and to execute, some effectual remedy for the present ruinous state of the harbour, which so much annoys the merchant and the mariner in the constant and regular exercise of business.

In considering the improvement of the harbour of Dundee, the reporter has much pleasure in acknowledging the intelligent and professional information which he received in the various communications which he had the honour to hold with the magistracy, merchants, and gentlemen of the Trinity-house of Dundee, while making his observations on the harbour. Two things were specially pressed upon the attention of the reporter, viz. that more *berthage* and accommodation for shipping were required at the quays; and that the want of a greater depth of water, both at the entrance and in the interior of the harbour, was felt, to the extreme disadvantage of the shipping and mercantile interest of the port. With regard to the financial part of the undertaking, the magistrates having kindly taken this part of the case upon themselves, it does not come under the notice of the reporter to consider the state of the harbour fund, nor to apply an increased rate of shore-dues to the liquidation of any sum at which the work may be estimated, as the money to be laid out in the first instance is limited to a fixed sum, with instructions to design the improvements of the harbour in such a manner that the works may be advantageously continued, according to circumstances, at a future period. The harbour of Dundee in the course of last century has undergone several alterations by the erection of additional quays; and it appears from the third volume of the works of the celebrated Mr. Smeaton, that he had reported upon the improvements of this harbour, and suggested the clearing it of mud, by certain alterations upon the sluices of the scouring basin, and opening additional arches in the pier so as to admit a greater run of water through the harbour. In addition to these operations the eastern pier has been carried out to the length of 200 feet, and a detached pier in the same direction has also been extended towards the west rock.

It now falls to the reporter to lay his opinion upon the subject of improving the harbour of Dundee before the magistrates, which he gives as the result of all the attention in his power, as the importance of the subject, and the celebrity of those who have gone before him, seem to demand.

Appendix C.

Dundee.

No. 135.
Stevenson, on the improvement of the Harbour.

When the reporter contrasts the situation of this harbour with others which have come under his notice, he confesses that the situation of Dundee is by far the most sheltered and secure he has met with. Removed just far enough from the sea to be free of its violent surges, and situated on the banks of a river just rapid enough to be useful to the mariner struggling with a contrary wind in a narrow channel, its piers require no further strength than is necessary for the purposes of commerce. By an attentive consideration of the *set* or direction of the tides in the neighbourhood of Dundee, it appears to the reporter that the tide of flood sets up the frith along the north shore on the Angus side, and runs with considerable velocity past Carolina Point and the harbour of Dundee; while the ebb-tide *sets* off the Magdalen Yard Point, and runs down the southern or Fife side of the frith. It therefore appears that the principal means of scouring the harbour depends on the tide of flood, which enters with much rapidity at the four arches made for this purpose in the new pier The waters of the ebb-tide flow through the arch of the Craig bridge at the upper or western end of the harbour, but in a smaller quantity and with less *impetus.*

In both cases, however, the current is no sooner admitted with a great velocity, and proportionate pressure at those apertures, than it instantly expands over the whole surface of the harbour, and necessarily loses its *scouring* effect. The north side of the harbour is built in so irregular a manner, with projecting and receding piers, that they cause eddies, and form so many depositaries for the lighter particles, which would otherwise be carried along with the stream. Another evil of no less magnitude occurs in the southern piers of the harbour, which are constructed with no less than three large openings and two arched ways, which are greatly larger than all the apertures for scouring the harbour.

The water for scouring the harbour ought evidently to be pent up as much as possible, so as to promote the velocity of its passage through the harbour; but these openings have just a contrary operation: allowing the waters to expand, and acting as so many filters, it is let off in a purer state than when it entered the harbour, the bottom of which consists of successive layers of silt and earthy particles, and has lost in some places, as before noticed, even 6 feet of its natural depth. Now this must always be the case in a greater or less degree when the waters of the river are allowed to flow through the harbour as a method of cleaning it, even under the most favouable circumstances, such as the erection of parallel walls on the north and south sides, and the shutting up of all unnecessary openings: for the apertures intended for the admission of the current to scour the bottom must still be unavoidably less in capacity than the area of the harbour; because, if it were possible to make them equal, the current would be so strong that ships might as well lie in the open river. The water must therefore be always more rapid in the river than in its passage through the harbour, where the wake of each ship becomes an eddy, especially while the tide is low; and these causes operating together will continue to produce a greater or less deposition according to the circumstances of the case.

To put this matter in a clearer point of view, let us see what nature does upon the great scale; as, for example, in the extensive basin forming the frith of Tay. We there find that, in consequence of the rapidity of the current at the narrow passage in the neighbourhood of Broughty Castle, which may be viewed as the *scouring aperture* of the basin of the Tay, the water is from 40 to 80 feet in depth, and moves with a velocity which carries a great quantity of sandy particles along with it. But no sooner are the waters of this current allowed to spread and cover the basin of the Tay than the velocity ceases and the foreign matters fall to the bottom and form the various sandbanks which appear at low water. In a similar way the deposition of the silt and earthy particles brought down the river in speats is accounted for.

Now this view of the case is equally applicable to the harbour of Dundee, for, while the water preserves the velocity it acquired in the *scouring apertures* or arches in the quays, it carries all its foreign matters along with it; but the moment it is allowed to expand over the extent of the harbour, the deposition of these earthy particles begins; and in every case the well-known law in hydraulics holds good, that the pressure of a fluid, *or its scouring effect*, is in the ratio of the square of the velocity.

Assuming it therefore as a principle, that the harbour of Dundee, and the access to it, cannot be effectually kept clear without a command of *head-water*, the reporter finds himself obliged to revert to the use and application of a basin with sluices which may be used at low-water for the purposes of scouring and clearing the bottom. But as a basin for this purpose has formerly been in use, and has long since been laid aside as inadequate to the end in view, it becomes necessary to inquire into the cause of this failure before bringing forward a similar measure. The scouring-basin formerly in use is situate on the north side of the harbour, as may be seen by referring to the plan. It was only applicable to clearing the lower part of the upper harbour, while all the other parts were left quite unprovided for, so that it is extremely defective in position.

Further, its area being only about one-twentieth part of the dimensions of the upper harbour, it was quite inadequate to the purpose of clearing the mud even out of that part of the harbour. The queries therefore come to be, What is the proper situation for this *scouring-basin?* and, What ought its dimensions to be?

This leads the reporter to propose what he conceives to be a very important improvement. In order to procure an adequate scouring-basin, or substitute for one, it seems advisable to convert the whole or a part of the upper harbour into a wet-dock, in such a manner as to answer the double purpose of keeping ships always afloat and (being provided with the necessary sluices) of being occasionally used for clearing the lower harbour and its access, which would then become the only entrance both to the lower and outer harbour, and also to the wet-dock. Such a design gives at once the best possible position to the scouring-basin, and affords ample capacity for the retention of water for clearing the bottom, and access to the outer harbour; and it would, in the most eligible manner, relieve the north quay of the incumbrance and intolerable nuisance of the present scouring-basin.

It is hardly possible to enumerate all the advantages, in a commercial point of view, which are to be derived from ships always lying afloat, as they are equally applicable to the most minute conveniency of the mariner, as subservient to the extensive and important concerns of the merchant, from the safety, facility, and regularity of loading and discharging vessels. Nor is the privilege usually given to ports possessing a wet-dock, of establishing bonded cellars, to be slightly overlooked; as, in many points of view, this becomes an object of great commercial importance.

In illustration it may be noticed as a fact fully ascertained with regard to wet-docks, that, notwithstanding the difficulties which attend the navigation of the Mersey or channel leading to the harbour of Liverpool, yet such is the facility given to commerce, and the conveniency of the berthage of ships in

APPENDIX C.

DUNDEE.

No. 135.
Stevenson, on the improvement of the Harbour.

the wet-docks of that place, that merchants from all parts of the kingdom have become settlers at that port. From the want of such accommodation, Lancaster has almost lost its whole trade; and it is said that Bristol was in some danger of sharing a similar fate previously to the establishment of its extensive wet-dock. The advantages of having vessels lying always afloat in perfect safety without the waste of cordage, with their *gunwales* always at a uniform height above the quays, without stoppage in loading and delivering from the rise or fall of the tide, and the benefits of bonded cellars, are considerations of such importance in a commercial and economical point of view, that it seems idle to insist upon them in reference to the prosperous and extensive trade of Dundee.

It shall therefore only be further noticed that the system of wet-docks has been adopted to a great extent in London, Hull, and Leith, and such docks are projected in Aberdeen and other parts. The situation of Dundee is peculiarly well adapted for the establishment of the wet-dock system, and that to a very great extent, where a single *water-tight* wall, extended from the present harbour towards Carolina Point, is capable of converting about 55 acres into a chain of spacious wet-docks. Dundee is so closely bounded on the north by rising grounds (which, in some places, are almost precipitous) and on the south by the Tay, that, although its situation is certainly one of the most delightful in the north of Scotland, yet these natural boundaries have in all probability hitherto prevented its extension upon any modern plan of elegance. Of late years, however, houses for genteel residence have been built towards the west end of the town, which will likely extend more and more towards the beautiful rising grounds of Blackness; while for wharfage and for places of business the town is advancing to the eastward. In this direction it appears to the reporter that an extent of land might be beneficially acquired opposite to the different properties bounded on the one side by Seagate Street, and on the other by the river. In connexion with these views it seems to be of much importance for the general conveniency of the town that a more intimate and direct communication should be opened between the Seagate Street and the harbour, by the removal of some houses which stand in the way. But, to return to the accompanying plan, it will be observed that the proposed wet-dock extends from the new pier along the front of the public warehouses to the road leading down to the Craig Pier, where the western wall is set off at right angles and joins the southern walls, which are connected with the new pier, forming an area of about 3¼ acres, and affording accommodation for 65 ships of 100 tons, and *berthage* of 1810 feet in extent along the quays of the dock, instead of the present highly inconvenient berthage of the upper harbour, which cannot be reckoned at more than from 500 to 600 feet. By this design, as appears from the accompanying plan, it is intended that the greater part of the carpenter's yard, belonging to the public, at the west end of the harbour, shall form part of the wet-dock. But it is also intended to restore the same extent of surface at the western extremity of the harbour, which may either be used for building warehouses upon and for the ordinary purposes of the berthage of vessels, or may be converted into a carpenter's yard, in which case a *graving-dock* for repairing ships can be conveniently got even at a comparatively small expense, as the ground may be made up with the silt and stuff taken from the bottom of the wet-dock. If, as here supposed, the graving-dock is made to enter from the wet-dock, it would require to have a sluice in it towards the river for the purpose of discharging the water when filled.

One obvious means of admitting ships of a greater draught of water into the harbour has been pointed out to the reporter, viz. by extending a pier from the new quay towards the rocks called the "Gryces." Perhaps this object would be better accomplished by carrying a pier to the Craig Rock, and then to return it to the eastward of the Gryces, and from thence to the west rock, forming the extended harbour (which could be kept clear of mud by sluices from the wet-dock) represented by the single dotted lines on the plan. But to enclose this space for an outer harbour, no less than about 2000 feet of piers would be required; and as the extremity of every pier projected across a direction of the stream must always form the boundary of deep water, the erection of piers towards the Gryces must be regarded as a manifest disadvantage to the whole property to the eastward of the present harbour, as tending to lessen the depth of water in that direction. A harbour extended towards the rocks would no doubt command 4 or 5 feet of water in the entrance at the lowest spring ebbs. But a similar depth of water may also be obtained, and at one-third of the expense, by continuing the present south pier in a south-easterly direction towards the rock called Bell's Rock, as marked in dotted lines upon the plan.

The advantages of extending the harbour in this direction would be very considerable, besides being executed at less expense. Were the entrance to the harbour transferred from its present situation to Bell's Rock, there would be from 3 to 4 feet of water at the pier-head at spring ebbs, and the shipping would be saved the present troublesome and difficult passage round the Fowler, the Beacon Rocks, and the Gryces; and ships either making the harbour or *casting off* from the pier-head, would get immediately into the proper *tideway* without the present circuitous and rather intricate track.

Another object, which is to be regarded as of the last importance in the extension of the piers, is to do it in such a manner that there may be a certainty of the permanency of the depth of water thus obtained. This, no doubt, would be the case at the entrance of a harbour carried out to the Gryces. It is an effect also no less certainly to be depended upon in carrying the south pier to Bell's Rock; because it lies directly in the currents both of the flood and ebb tides, which set upon it in passing from Carolina Point to the Magdalen-Yard Point, and *vice versâ*.

These are to be considered as the points of land, immediately above and below the harbour, which must always regulate the *sets* of the tides in the immediate neighbourhood of Dundee; and there is every reason to believe that, were the south pier continued to Bell's Rock, the present depth of water round it would be considerably increased.

In contemplating an improvement of this nature, it may reasonably be supposed that the present lower harbour will in its turn be converted into a wet-dock as the trade increases, and that cross-piers may in time be projected both from the west rock and from Bell's Rock, so as to connect them with the north shore, and thereby to include the whole of the present wharf of the Seagate Street into a new outer harbour, as represented on the plan.

The works which the reporter has thus described are calculated, in the first place, greatly to extend the berthage or accommodation of the harbour of Dundee; and secondly, upon the most sure principles, to obtain and permanently preserve a depth of water to the extent of about 21 feet at high-water at ordinary spring tides, which is sufficient for floating, not only the largest merchant-ships with their cargoes, but also the smaller classes of his Majesty's ships of war. In taking so extended a view of the improvements of the harbour of Dundee, the magistrates are no doubt

APPENDIX C.

DUNDEE.

No. 135.
Stevenson, on the improvement of the Harbour.

aware that the reporter must have greatly exceeded the amount of the sum of 21,000*l.* which is now proposed to be laid out on those works. He will not, however, be understood to have at all exceeded the liberal instructions given him by the chief magistrate, having endeavoured to design the works in such a manner as that they may be progressively executed—the part to be first done calculated so as not to affect the general plan of more extensive operations.

What the reporter now begs leave to press upon the notice of the magistrates and town-council, as the work to be first attended to, is to convert the upper harbour of Dundee into a wet-dock, of 3¼ acres, agreeably to the accompanying plan and sections.

To execute this wet-dock in a substantial manner, and with convenience to the shipping of the port, will require a period of three years, and, with its retaining walls, gate, cast-iron *swivel*-bridge on the new pier, and culverts with sluices for securing the outer harbour and its entrance, agreeably to the annexed estimate, will cost the sum of 34,902*l.* 10*s.* 6*d.*

Should the magistrates, after considering this subject in all its bearings, find their funds inadequate to the complete execution of the wet-dock, it may be specified, in the first instance, to erect the face-wall of the dock on the north side of the upper harbour, and the south pier parallel to it, together with such other parts of the design as the funds can be made to cover. It would, however, be far more desirable, and ultimately more convenient, if means could be devised for raising the whole sum within three years. With this view, it may be proper to consider the eligibility of levying dock-dues, upon a similar principle as is provided for in the Act for the wet-docks of Leith; and with about 130,000 tons of shipping *per annum*, which it is believed may be calculated upon at Dundee, even a moderate scheme of shore-dues would yield a sufficient guarantee for a very large sum of money. Nor in any scheme of finance should the valuable fees for warehouses and bonded cellars be overlooked as *items* in the funds of the harbour.

For this purpose the excavated area of the present scouring basin may be converted into vaults under the projected range of warehouses marked on the plan along the north side of the dock; and were this mode of cellarage continued further to the westward than the basin, agreeably to the section delineated on the plan, the stuff thus excavated might be conveniently used as *forcing* behind the face-walls of the dock.

The reporter, in estimating these works, has been desirous of giving as correct a view of the expense as possible; but in all operations of this kind, especially where a junction between old and new work is proposed, the estimate cannot be so well defined as for works entirely new; and therefore, the better to provide for such circumstances, no deduction is made upon the estimate for the materials of the piers which fall to be removed in the course of these operations. In the present state of matters it is unnecessary to enter into a more particular specification of the proposed works; but in the mean time, should any further information be required, the reporter will be most happy to furnish it.

The plans for the improvement of this harbour do not include any material alterations upon the landing-place for the ferry-boats at Dundee; but when that ferry is put under the control of the magistrates, as trustees, it will then be proper to take up this subject, with a view to the establishment and improvement of different boat harbours, both on the Angus and Fife sides of the Frith of Tay, for the greater safety of passengers and despatch of travelling.

ROBERT STEVENSON.

The Magistrates and Town-Council, Dundee.

Estimate of the Expense of converting the upper or western part of the Harbour of Dundee into a Wet-Dock.

Southern Wall.

	£.	s.	d.
For 1066 cubic yards of excavation in digging and preparing the foundation of the southern wall of wet-dock, at 2*s.*	106	12	0
For 30,000 cubic feet of square masonry in the face-wall of the quay, at 2*s.* 4*d.*	3,500	0	0
For 5555 cubic yards rubble-building in the backing, counterforts, and puddle walls, at 10*s.*	2,777	10	0
For 1422 cubic yards of clay puddle, at 2*s.*	142	4	0
For 6666 cubic yards of *dry stone* building in the hearting and outward wall, at 8*s.*	2,666	8	0
For 335 cubic yards of coarsed rubble-work with ashlar, cope in parapet, at 20*s.*	335	0	0
For 33 roods of paving for the roadway of the quay, at 108*s.*	178	4	0
For northern wall, calculated upon data similar to the southern wall, including *forcing* to make up the ground behind the quay	5,940	0	0
For western wall	4,856	12	6
For eastern wall, with entrance lock, one pair of gates, culverts for scouring the outer harbour and accommodation, swivel-bridge of cast iron	9,630	0	0
For 20,000 cubic yards of excavation in clearing and deepening the bottom of the wet-dock, at 2*s.*	2,000	0	0
For wooden fenders, swivel-rings, &c., for the dock	500	0	0
For incidents	2,270	0	0
Total for the wet-dock, including the materials of the old piers	£34,902	10	6

No. 136.

THOMAS TELFORD, Esq., C. E., *on the Works at Dundee Harbour.*

No. 136.
Telford, on the works of the Harbour.

THE town of Dundee is situated on the east coast of Scotland, in 56° 27′ north latitude, and 3° west longitude, and on the north side of the Tay estuary, which is there nearly two miles wide. About three miles below the town the estuary is contracted to half that breadth, and thence widens, until, at seven miles' distance from this narrow gorge, it is terminated at the northern extremity of the Bay of St. Andrews by a bar, upon which there is from 2 to 4, 5, and 6 fathoms at low water of an ordinary spring tide. All above Broughty Castle is a well-protected roadstead, with 3 to 10 fathoms water. The expanse opposite the town of Dundee, and consequent retardation of current, has permitted the formation of a sandbank; but as this does not occupy one-third of the water-way, and is in a longitudinal direction, plenty of space remains for navigation on each side of it.

APPENDIX C.

DUNDEE.

No. 136.
Telford, on the works of the Harbour.

Until the beginning of the present century, in consequence of the excellence of the roadstead, business was transacted with the aid of very imperfect wharfage on the shore. The hemp and linen manufacture has long been the staple of Dundee; and during the long-continued wars from 1793 to 1815, canvas and coarse bagging were made in large quantities, by which, and engaging largely in the transport service, the industrious inhabitants increased their activity and wealth; and this being also the principal town and port of the Carse of Gowrie, with the extensive and thriving Strathmore behind it (the richest agricultural district of Scotland), accumulated capital centered in the Dundee banks. On the termination of the war, employment of transports also ceased, and the intelligent merchants and manufacturers perceived that they must employ larger vessels for longer voyages, and seek more distant connexions; and that with this view accommodation for suitable shipping must be provided, in the same manner as had already been done in other places of much less promise and importance.

In fact, the growing prosperity of Dundee fully justified considerable efforts. The harbour-dues in 1765 only produced a gross sum of 126*l.*; in 1800 they amounted to 1300*l.*; and in 1814 to 1701*l.* Until this time the harbour-dues were entirely in the hands of the corporation, collected and applied promiscuously with the town revenue; and in the 10 years previous to 1815, although 13,817*l.* had been collected, no more than 1193*l.* had been expended upon the harbour and wharfs. But it was now discovered that the prosperity of the port was connected with that of the district at large, so that not only the resident merchants and manufacturers, but the landowners and agricultural capitalists, were zealous for harbour improvement. From the past conduct of the Corporation and their confined views, no prospect existed of obtaining suitable accommodation under their management, as indeed was fully evidenced by their instructions to me, which went only to form wharfs and quays for a tide harbour, and it was to this only my plan of 1814 extended; but I, at the same time, pointed out in what manner a floating-dock might be obtained.

A number of public-spirited individuals, having interposed, overpowered the Corporation, and the exclusive management of the harbour was put into the hands of public Commissioners. From this date enlarged views were developed, and a plan for an extensive floating-dock was formed, also for a graving-dock for large vessels, and for entrance-piers protecting the inner or western tide harbour, which was to be greatly enlarged and deepened. An Act to this effect having been obtained in 1815, the works were prosecuted with successful energy, and the floating dock was opened on the 23rd November, 1825, to the entire satisfaction of all parties. The trade has ever since enjoyed the desired accommodation; and instead of too much having been done, as foretold by the Corporation, the dock has been found insufficient in extent, and in 1830 powers were obtained to construct additional new docks to the eastward.

The conduct of the Dundee Corporation forms a striking contrast with that of Aberdeen. The management of the port was taken out of the hands of the former, because their views did not keep pace with the growing demands of commerce; whereas the latter have been exposed to obloquy and parliamentary persecution for proceeding on too extensive a scale of improvement.

The Dundee floating-dock already completed is 750 feet in length and 450 in breadth; its entrance-lock is 170 feet long and 40 feet wide. The floor of the graving-dock is 265 feet long, 40 feet wide at bottom, and 68 at top. There is 16 feet of water on the sill of the entrance-lock at high water of an ordinary spring tide.

The harbour-works were placed under the superintendence of Mr. David Logan, but he preferred employment at Donaghadee Harbour when the Dundee improvements were about half completed, and was succeeded by his cousin Peter Logan, both of them active young men, who conducted the works to my entire satisfaction. The intelligent Secretary of the Trustees, James Saunders, has by his perseverance and enlightened conduct greatly contributed to the growing prosperity of the port. I here annex information furnished by him in the year 1830.

The following is the average of tonnage taken every three years:—

1799 to 1803 inclusive	63,519	annually.
1804 " 1808 "	63,519	"
1809 " 1813 "	69,293	"
1816 " 1820 "	92,390	"
1821 " 1825 "	123,186	"
1826 " 1830 "	150,915	"

Or comparing two single years:—

From May 1829 to May 1830	182,512
" 1826 " 1827	128,811
Increased tonnage	53,701

The expense of the works above described was 119,855*l.*

From May 1816, to May 1817, 5900*l.* harbour revenue was collected by the Trustees; and in 1829 to May 1830, 11,645*l.*

Previous to 1815, when the improvements were commenced, the greatest import of flax and hemp in one year was 3000 tons; in the year ending in May 1830, it became 18,557 tons; in the year ending in May 1831, there was shipped 356,817 pieces, measuring 50 millions of yards; also sail-cloth, 85,522 pieces, measuring 3½ millions of yards; and bagging 62,199 pieces, measuring 4 millions of yards; total 57½ millions of yards. The value of hemp and flax imported, 700,000*l.*; of goods shipped 1,500,000*l.*

Since the harbour has been completed, a considerable number of large vessels are employed in trading with the American United States, British America, South America, and the West Indies; and hemp, flax, and tallow are imported from Archangel in the North Sea, from Petersburgh, Riga, and other ports in the Baltic.

In the enumeration of 1801 the town appears to contain 26,804 inhabitants; in 1831 the number was 45,355.

THOMAS TELFORD.

No. 137.

Jardine, on the extension of the Docks, and Estimate.

No. 137.

Report of JAMES JARDINE, Esq., C.E., *relative to the extension of the Docks, and Estimate.*

Edinburgh, February 1, 1830.

IN consequence of a letter from James Saunders, Esq., clerk to the Commissioners, dated 30th July 1829, and written instructions delivered to me at Dundee on the 13th of August last, by Christopher Kerr, Esq., town-clerk, I commenced a survey of Dundee Harbour and the adjacent houses and grounds on the latter day; and, having some time since completed the survey, and relative plan, in duplicate, I beg leave to submit the following report.

On surveying the present wet-dock, tide-harbour, and shore to the east and west thereof, and examining the shipping and trade of the port, it soon became quite obvious that the rapidly increasing shipping of Dundee could be accommodated best by constructing wet-docks to the eastward of the present wet-dock. With that view I have delineated on the plan two wet-docks, and a tide harbour to the eastward of the present wet-dock. The first of these, or middle dock. is on an average 380 yards long, 120 yards wide, with 990 yards of dock-wall or berthage for ships, and containing 9¼ imperial acres. The eastern dock is 360 yards long, 120 yards wide, with 932 yards of berthage, and containing nearly 9 imperial acres. These two wet-docks are separated from one another by a lock with double gates, of which the sills are proposed to be placed 3 feet deeper or lower in level than those of the present wet-dock. Over the middle of the lock a swivel-bridge will complete the communication between the two sides of the dock. It is stated by Mr. David Peter that the present east wall is founded deep, and is quite sufficient without alteration for the western wall of the proposed new wet-dock. The eastern dock is separated, in the same manner, by a lock from the spacious tide harbour, into and out of which ships may sail with freedom.

It is a matter of the first importance, in choosing the sites of wet-docks, to have a good bed of clay or rock at a proper depth for the foundations of the dock-walls and locks. This was ascertained to be the case in the present instance, by a great number of bores in the sites of the proposed wet-docks, and the fractional numbers on the plan indicate the depths in feet of the surface of the bed of clay below the level of the top of the quay-wall of the present wet-dock.

In the annexed estimates, in which the prices are the same as those of the present wet-dock, it appears the probable expense of executing the proposed middle wet-dock will be 65,506*l.*; of the eastern wet-dock, 65,110*l.*; and of the tide harbour, 24,717*l.*

The sea-wall is not included in the foregoing estimates, as the increased value of the made-up shore-ground between it and the docks will amply repay the expense of the sea-wall.

Supposing that I have selected the proper situation for the extension of the harbour, and allowing not less than 20 yards broad to the north of the docks for landing-sheds and quay-room bounded by the dotted line, 20 yards more for a public thoroughfare street, the proprietors of the houses and ground on the north shore might be allowed to fill up the ground, and build houses to a straight line not less than 40 yards north from the north walls of the proposed wet docks and harbour, with a servitude of a public street not more than 20 yards wide from the fronts of the new houses, upon giving up every claim, right, and title they have, or pretend to have, in the shore-ground and tide-water to the south of the aforesaid dotted line. Cross streets properly arranged would open up excellent communications with Arbroath, &c., and the continuation of Dock-street eastward would form an admirable level road to Broughty Ferry.

Notwithstanding the excellent adaptation of the eastern shore to wet docks, Mr. Saunders came here in consequence of the petition of "one hundred shipowners," and urged me strongly to delineate a wet dock on the site of the west tide harbour, on the plan prepared to be lodged with the clerk of the peace. I explained to him that it was too late to alter the plan, and that, should it be ultimately deemed advisable to construct a wet dock in that place, the Committee of the House of Commons, as in similar cases, could easily delineate the site of that dock on the plan.

However, I embraced the first opportunity that offered to examine the western tide harbour again, and have delineated a wet dock on it. I wished to have placed the entrance lock on the middle of the south side, like that of the present wet-dock, but found that there would not have been room for an ordinary vessel either to have got into or out of the dock.

Mr. David Peter states that the east and north wall are good, but that most of the west wall was defective, and will require to be taken down and rebuilt. The average length and breadth are 150 and 120 yards, containing nearly 4 imperial acres, and having nearly 530 yards of berthage. The estimated probable expense, at the same prices as the others, is 34,696*l.*

Having completed the survey of the harbour of Dundee, and delineated on the plan the situation of wet docks for the accommodation of the shipping and trade of that very thriving port, I am very anxious the plan should be submitted to Mr. Telford, whose eminent skill and great experience well entitle him to judge in such matters.

I cannot in justice close this report without expressing my obligations to Messrs. Kerr and Saunders for their promptitude and assiduity in furnishing me with every local information which circumstances required.

JAMES JARDINE.

The Provost, Magistrates, and Harbour Commissioners, Dundee.

ESTIMATES OF THE PROBABLE EXPENSE OF THE PROPOSED WET-DOCKS.

1. *The first or middle new Dock.*

	£.	s.	d.
Cutting foundations of wall, 21,160 cubic yards, at 2*s.* 6*d.*	2,645	0	0
Ashlar in north-east and south dock-walls and entrance lock, 11,565 cubic yards, at 33*s.*	19,082	5	0
Rubble in counterforts and backs of walls, 20,211 cubic yards, at 25*s.* 6*d.*	25,769	0	6
Platforms, dock-gates, capstans, chains, &c. of lock, complete	4,200	0	0
One half of drain or sewer along Dock-street, the proprietors of houses paying the other half	375	0	0
Swivel-bridge over middle of lock	345	0	0
Excavating the inside of the dock to the depth of 3 feet below the level of the tops of the clap-sills, 114,000 cubic yards, at 1*s.* 3*d.*	7,125	0	0
Contingencies, exclusive of the expense of Acts of Parliament, 10 per cent.	5,954	14	6
	£65,506	0	0

APPENDIX C.

DUNDEE.

No. 137.
Jardine, on the extension of the Docks, and Estimate.

2. *Eastern Wet-Dock.*

	£.	s.	d.
Cutting foundations of walls, 12,260 cubic yards, at 2*s.* 6*d.*	1,532	10	0
Ashlar in walls of eastern wet dock and entrance lock, 10,522 cubic yards at 33*s.*	17,361	6	0
Rubble in counterforts and backs of walls, 16,883 cubic yards at 25*s.* 6*d.*	21,525	16	6
Platforms, dock-gates, capstans, chains, &c. of lock complete	4,200	0	0
One half of common sewer along Dock-street	375	0	0
Swivel-bridge over the middle of entrance locks	345	0	0
Excavating the inside of the dock to the depth of 3 feet under the level of the top of the clap-sills, 90,720 cubic yards, at 1*s.* 3*d.*	5,670	0	0
Contingencies, exclusive of the expense of Acts of Parliament, 10 per cent	5,100	7	6
	£56,110	0	0

3. *Eastern Tide Harbour.*

	£.	s.	d.
Cutting foundations of walls of tide harbour, 5200 cubic yards, at 2*s.* 6*d.*	650	0	0
Ashlar in walls of tide harbour, 5500 cubic yards, at 30*s.*	8,325	0	0
Rubble in backs of walls and counterforts, 10,584 cubic yards, at 25*s.* 6*d.*	13,494	12	0
Contingencies, exclusive of the expense of Parliament, 10 per cent.	2,247	8	0
	£24,717	0	0

4. *Proposed Wet Dock in Western Tide Harbour.*

	£.	s.	d.
Cutting the foundations of walls, 8163 cubic yards, at 2*s.* 6*d.*	1,020	8	6
Ashlar in walls, lock, and part of north wall, 5432 cubic yards, at 33*s.*	8,962	0	0
Rubble in walls, 7310 cubic yards, at 25*s.* 6*d.*	9,320	5	0
Taking down and rebuilding west wall, 3451 cubic yards, at 27*s.*	4,658	17	0
Cutting foundations of west wall, 2928 cubic yards, at 2*s.* 6*d.*	366	0	0
Platforms, dock-gates, capstans, chains, &c. of lock complete	4,000	0	0
Common sewer on north side of dock	210	0	0
Excavating the bottom of the dock to the depth of 3 feet below the level of the tops of the clap-sills, 48,055 cubic yards, at 1*s.* 3*d.*	3,003	8	9
Contingencies, exclusive of the expense of Acts of Parliament, 10 per cent.	3,154	4	9
	£34,696	0	0

No. 138.

No. 138.
Gibb, on the proposed Works.

Report by JOHN GIBB, Esq., *on the proposed Works in Dundee Harbour.*

GENTLEMEN, *Aberdeen, May*, 1831.

AGREEABLY to your instructions, communicated to me by your Secretary, Mr. Saunders, who put into my hands the plan which had previously been submitted to, and the general principle approved by, Mr. Telford on the 8th, 9th, and 11th ultimo, I carefully examined the harbour of Dundee; also attended a meeting of your Committee, examined your quarries at Locbee as to their capability of producing stones sufficient for the works proposed; likewise attended a meeting of a committee of the Ferry Trustees, and accompanied the Honourable Colonel Hallyburton (one of their number) to the harbour, and explained to him the improvements contemplated; had several communings with your Secretary, and Mr. David Peter, your Overseer.

But it appeared to me that, by the plan which was handed me, the outer or western protecting wall was only intended to be carried to within about 100 feet of the southern point of the eastern breakwater of the Ferry harbour, which would have a projection of this length only to be a deposit for mud, as it is obvious that the accumulation of stuff which takes place in this harbour is occasioned by the flood-tide, and having an opening left on the outer side of the present protecting pier, so that, if this opening is filled up, and all projecting points got rid of, the water running through the upper arches, on the ebbing tide, would keep the ferry harbour clear of mud, and the inside of the space proposed to be built up will afford well-sheltered berthage to the spare steam-boat and sailing craft, for which the Ferry Trustees are obliged to have recourse to the harbour of Dundee.

The extension of the western protecting wall of Dundee harbour to the extremity of the point of the breakwater of the Ferry harbour will have another beneficial effect, especially as the direction of this wall falls to be laid in the line of the rocks called the Gryces, with the exception of one which can be easily quarried, consequently cover this dangerous reef, which must, whilst they remain exposed, render the navigation of the ferry steamers a matter of considerable difficulty and risk in strong south-westerly winds, when near low water. And were it not for the very superior manner in which the operations of this ferry have hitherto been conducted, the Trustees must, ere this time, have felt the difficulty in a much greater degree.

They will, however, when the new protecting wall is erected, have access to any point; and when their vessels approach the harbour in stormy weather, it will be no difficult matter to render assistance, which, with an insulated structure, as it is at present, their breakwater is comparatively of little utility in this respect. And the opening between it and the western wall not only lays the Ferry harbour open to east and north-east winds, but renders it constantly liable to be filled up with mud.

I am therefore of opinion that the plan proposed will, in various ways, tend greatly to improve and preserve the Ferry harbour in a much safer and better state than heretofore.

By the plan which accompanies this, it will be seen that I propose that the present western protecting pier, with the exception of the circular head and small piece within it, shall be removed and rebuilt in a straight line, between the extreme point of the Ferry breakwater, and the present head, agreeably to the transverse section. This extension will increase the size and improve the shape of the dock to be formed within.

The tide or entrance lock, which I have endeavoured to place in the most advantageous position for egress and protection, I recommend should be made 175 feet long, clear space within by 45 feet

APPENDIX C.

DUNDEE.

No. 138.
Gibb, on the proposed Works.

wide, in the manner represented on the enlarged plan, and to have the sill laid at 18 inches lower than the present tide-lock, so as to admit of large steamers, and of other vessels of larger dimensions and a greater draught of water than the present entrance-lock.

The ground which will be acquired on each side will also give accommodation for slips, wood-yards, or warehouses, as the Trustees may afterwards deem most advisable, and likewise afford great additional berthage.

In addition to the extension of the west wharf, so as to unite the wharf on the inside of the new protecting pier, the present west wharf must be taken down and the foundation laid to the proper depth, and the wall rebuilt in such a manner as to render it water-tight. It is also proposed to cut a trench across the root of the present projecting jetty for a puddle-wall, so as to connect with the puddle behind the north walls on each side, and to extend the middle jetty in the manner represented on the plan.

When all these works are completed the western wet-dock will possess the following advantages over the present dock,—a larger lock, 18 inches more water, and consequently capable of admitting a large class of vessels, and of having more quay-berthage.

It is also of great importance to the mercantile interest to obtain this great additional accommodation in the vicinity of the busy part of the town, so near the present places of business, which will greatly economise the time of exporters and importers, as they can in a few minutes walk from their warehouses to the quays.

The saving of cartage will also be considerable, especially in the articles of coal and other raw materials, as most of the large manufacturing establishments are situated to the westward.

The Trustees will also get rid of the constant annual expense of keeping the present dry harbour clear of mud, and the inhabitants who live in the vicinity will constantly enjoy the pleasant prospect of a sheet of water in place of the noxious appearance of the mud every six hours.

Before proceeding to the details of the specification, it may be proper to give an outline of the manner in which I would advise the proposed works should be carried into execution:—

1. The outer face of the western projecting pier should be completed for the whole length on the outside, and as far as the cross-wall at the outer end of the entrance-lock on the inside, with a sufficient embankment, and puddle-wall at the back of the outer protecting wall, so as to support and keep it water-tight.

2. And also the outer wall on the west side, filling up the opening from the Ferry harbour, with a proper embankment, and puddle behind, so as to render it water-tight.

3. A coffer-dam of rubble-stone will then have to be carried across between the south corner of the external wall of the present wet-dock and the inner face of the outer protecting pier, having a sufficient space clear for constructing the tide-lock within.

When this dam is constructed it will be obvious that the whole of the interior may be kept dry by the assistance of a small steam-engine; and thus the tide-lock and the different walls connected, together with the walls on the inner side of the protecting pier, that opposite the Ferry harbour, the rebuilding of the west wharf, the extension of the middle jetty, the excavation of the harbour, and, in short, all the works in the interior, may be completed without being subjected to tides' work.

By this arrangement the Trustees, should they deem it advisable, can carry on the whole of the operations at once, saving both time and money, besides getting their works executed in a much more perfect manner than it is possible to do by tides' work.

JOHN GIBB.

To the Harbour Trustees, Dundee.

SIR, *Aberdeen, May* 11, 1831.

SINCE my general report was written I have considered the observations in your letter of the 6th instant respecting the breakwater. As far as I am enabled to judge from what you state, I do not see any objections as regards the harbour of Dundee. But if a breakwater shall be required for the protection of the Ferry harbour, it can only be useful if constructed nearly in the direction of north-east and south-west, placed at such a distance from this harbour as to leave an opening of at least 90 feet at each end. But a breakwater of this description, although it did afford additional shelter, would occasion much more difficulty in navigating the steamers. I would therefore advise not to attempt any new building until experience has shown whether any would he found necessary.

I am, &c.,
JOHN GIBB.

James Saunders, Esq., Clerk to the Trustees,
Harbour, Dundee.

No. 139.

No. 139.
Gibb's Second Report on the Harbour.

Mr. GIBB'S *Second Report on the Harbour of Dundee.*

GENTLEMEN, *February* 29, 1832.

ON receipt of Mr. Saunders's letter of the 22nd, desiring that I should visit your harbour, I made the necessary arrangements to enable me to come here with the least possible delay.

Yesterday I attended a meeting of your committee of works, and, after receiving their verbal instructions, some of the gentlemen accompanied me over the works now in progress. I have since been part of two low-water tides on the work; and Mr. Saunders handed me a copy of the minute of the committee of the 11th of January last, on all which I shall endeavour to state my opinion.

First. It appears from the minute, that in carrying into execution the works necessary for converting the present dry harbour into a wet dock, it is indispensable, from the great demand for berthage, that any part of the western wall, as soon as it can be rebuilt, should be immediately occupied with shipping.

Second. That the works intended to be done should be carried into execution with much greater expedition than the present scale of operations is calculated to accomplish; and the additional utensils required for the above purpose.

Third. As to the mode of pumping, digging, &c. &c.

Fourth. As to the repair and reconstruction of the crane lately damaged in taking out the steam-boiler,

APPENDIX C.

DUNDEE.

No. 139.
Gibb's Second Report on the Harbour.

Fifth. As to the propriety of constructing at present a more powerful crane for taking out and putting in boilers.

I shall therefore endeavour to state my opinion on the different points referred to by the committee of works, and some other matters which have occurred to me as necessary to be attended to in the present state of the works.

First. It appears that, in order to render the west wall as speedily as possible fit for berthage, and at the same time carry on the other works with the desired expedition, it will be necessary to procure without delay five new building barges, mounted with light cranes, and to convert the new lime-lighter into a building barge, there being no use for a lime-lighter at the west wharf, because it will be cheaper and better to work the lime in the shed, wheel it out, and put it down to the building in spouts. But I advise that the new barges be built in the form of square punts, which can be done at less than half the expense of the crane-lighter lately built; and when they are no longer required for building, they can, at a trifling expense, be converted into punts suitable for conveying stuff from the dredging-machine, which at present has only about half the number available which it could keep in full work; at the same time the cranes which had been used in these punts could be erected on the railways for lifting the boxes containing the stuff taken up by the dredging-machine.

Second. The trustees would thus be enabled to carry on three additional compartments in rebuilding the west wharf, and also three additional on the outer and sea-wall.

Third. As it will be some time before the work arrives at a favourable position for fixing a steam-engine, I recommend that six chain-pumps be procured, which would be much more suitable for drawing the water, especially the muddy water, when the foundation comes near the depth, than the sludge-pumps now in use, which are better calculated for the top-lift. I also advise that a better mode of fixing the temporary cofferdams be adopted, of which I shall send a sketch and description in a few days.

As a very considerable expense is at present incurred by the mode of trimming the stuff from the dams and throwing it repeatedly back to a sufficient distance, and a good deal thrown into the harbour, which has again to be relifted, I recommend that, in place of repeatedly throwing the stuff from the bottom by the shovels, and again throwing it outwards, as soon as the dam is put in, that a crane-barge should be laid behind, and the iron boxes should be alternately filled and hoisted up to trucks placed on a temporary ladder-rail laid on deck, and emptied into a scoop behind; and at the west wharf, where a punt cannot be got behind, one of the dredging-punts may be laid alongside of the crane-barge for receiving the stuff, which could be carried and emptied behind the walls at high-water.

Having noticed the three first heads of your committee's instructions, I shall, before referring to the business of the cranes, take the liberty to offer a few general observations as regards the conducting of the work.

Although it is of the first importance to have proper utensils and materials, where works of such magnitude are to be carried on with expedition, at the same time it must appear that the greater the scale, it becomes the more imperative to observe the strictest economy in every department.

I therefore advise that in future every article should be procured by advertising for contracts for such proportions as the works may require for the season.

1st. Say sand by the ton, delivered at such parts of the work as the superintendent may direct; for which purpose the superintendent should be directed to examine the various banks, so as to be able to specify generally where it could be procured.

2nd. Lime, by the imperial boll, delivered at the work, both from Lord Elgin's and from Teasses; the latter shipped at Largo; said by Mr. Easson to be very good for water-work, and more profitable.

3rd. A punt and crane, mounted, complete, and ready for working, agreeably to model, plan, and specification, for a net sum.

4th. Each chain-pump, agreeably to pattern, at a price for each; to obtain which I beg to recommend that the chairman apply to the Aberdeen Harbour Trustees for one of theirs.

5th. Sludge-pump, leathers each agreeably to pattern and weight.

6th. Water-boots, agreeably to pattern and weight, per pair.

7th. Roman cement, first and second quality, per barrel delivered.

8th. Ropes, white and tarred, common and hawser, laid pattern and common, of best Riga, Rhine, or St. Petersburgh, clean, delivered at per cwt.

9th. Chains for working barrels of cranes, which I advise should be used as being much more economical than ropes, say $\frac{1}{2}$ inch, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, and 1 inch; together with small moorings for punts of $\frac{3}{8}$ inch; all of the best cable-iron, and short links, tested to a fixed strain before delivered.

10th. Nails of different descriptions as may be required.

11th. Timber, of the several qualities and descriptions as may be required.

Stone quarrying, &c. &c., being already done by contract, I have only to advise that distinct specifications as to dimensions be adhered to, so that the trustees do not pay for a greater breadth of ashlar-work than required, as being more expensive; and perhaps, to avoid this, it would be better to quarry and drive by the cubic foot in place of the ton weight; and therefore, by limiting the quarrier to a maximum breadth of ashlar and headers, if he sent them greater it would be his own loss.

By bringing every article to a fair competition I feel quite convinced the trustees will be enabled to effect a great saving on the whole.

Cast-iron crane.—With regard to the reconstruction of this crane, all that seems necessary is to strengthen the spindle immediately below the plate which is fixed into the stone, and to cast the new surface-plate a full circle, perforated so as to give an opportunity of putting more bolts into the stone all round; and in case the present stones are not large enough, suitable ones should be laid for this purpose. I do not think it advisable to increase the length of the jib, as it would have a tendency to weaken the crane.

In conclusion, I beg to recommend a little delay before coming to any decision about the erection of a very powerful crane, so as to give time to the trustees to consider whether a more safe scheme can be adopted for moving large boilers. Several of the gentlemen connected with the trust who are conversant in these matters will be better able to judge of the propriety of waiting a little.

I have instructed Mr. Easson about the squaring of the beds and joints of the ashlar-stone, most of which have been very imperfectly done, and require much additional labour in setting, besides a great waste of lime; and also to keep the quarriers to a fixed specification, so that the trustees should not have to pay for more than is required.

No. 139.
Gibb's second Report on the Harbour.

I am, &c.,
JOHN GIBB.

The Harbour Trustees, Dundee.

No. 140.

No. 140.
Leslie, on proposed jetty at Broughty Ferry.

Report by JAMES LESLIE, Esq., C. E., *on the proposed Jetty at Broughty Ferry.*

Dundee, November 25, 1835.

GENTLEMEN,

AGREEABLY to instructions, I have had a survey taken of Broughty Ferry with a view to fixing upon a site for a harbour or jetty, and a sketch of the general plan is herewith submitted to you, which, if approved of, will be sufficient for lodging in compliance with the standing orders; but the weather and the states of the tide prevented the soundings from being taken with sufficient accuracy for making out detailed plans and estimates.

The most commodious situation would probaby be that shown at the Castle and marked No. 1, but the plan would require to be on a pretty large and expensive scale, as the sea-arm of the south pier must necessarily be extended as far as the rock B, which otherwise would be quite in the way of the entrance. The average dimensions of this harbour are 360 × 330 feet, and its area up to high-water mark about 2½ acres.

The ebb runs very strong at this place, and I would propose to form the mouth of the harbour directly opposite the tide, and thereby cause a current to run through the harbour, and escape by openings in the pier A C over the low part of the castle rock; which would tend to prevent any deposit of mud from taking place inside.

This site has the advantage of being opposite ground otherwise unoccupied, and of being fit to be easily connected by means of a branch with the Arbroath Railway.

It may however be objected to on account of supposed injury to the salmon-fishings.

The other site proposed, as marked No. 2, lies between Fort-street and Dundas-street, and would be the most convenient for the fishermen.

It is also the place where the water deepens most rapidly, there being at the distance of 200 feet from high-water mark a depth of 10 feet at low water of spring tides. If a mere landing-place for passengers be all that is required, the western arm, or a modification of it, will be sufficient for the purpose; but to afford shelter to the fishing-boats, and safe berthage for vessels discharging coal, lime, &c., it will be necessary to have also an eastern pier for protection in south-easterly gales, in which case it may be proper to leave some openings in the west pier to cause a current to run through the harbour. The average dimensions of this plan are 270 × 165 feet, and its area is a little more than an acre.

Two other plans for a jetty merely are shown at the foot of Fort-street and Gray-street, and are respectively numbered 3 and 4.

As a criterion to judge of the dimensions spoken of, I may mention that the area of the Dundee tide harbour is 4¾ acres, and that of the Craig pier 1¼ acres.

I beg leave likewise to submit to you a plan of a low-water pier upon the Beacon Rock, and the space between it and the Fowler Rock, connected with the eastern sea-wall by means of a suspension bridge or a roadway, otherwise supported upon some description of open work, which would form no obstruction to the set of the tide along the face of the wall, the details of which may hereafter be arranged.

I am, &c.,
JAMES LESLIE.

The Trustees of Dundee Harbour.

No. 141.

No. 141.
Leslie, on the progress of improvements in the Harbour.

Account of Dundee Harbour, and of the progress of its Improvements, by JAMES LESLIE, Esq., Cor. M. Inst. C. E., *Engineer of the Works.*

Dundee, December, 1838.

IN the following notice it is to be understood that my personal observation goes back only to the spring of 1832.

The town of Dundee is situated on the north shore of the river Tay, or rather of its estuary, which at that place is a mile and a half in width; but it contracts at Broughty Ferry about 4 miles farther down to a strait of ⅞ths of a mile across. There are sandbanks on the right hand considerably above the level of low-water for the distance of 6 miles below Broughty Ferry, and there is no free passage to the southward at low-water before rounding the Fair-way Buoy of Tay, which is placed 12 miles below the harbour of Dundee.

The mouth of the river, as fixed by a decision of the House of Lords in a matter concerning the salmon-fishings, is at the Gaa of Barry, 5 miles below Broughty Ferry; and the bounds of the harbour within which dues are levied extend 12 miles alongshore from the mouth of the river to Invergowrie Burn, a distance of 3 miles above Dundee.

The earliest authenticated plan of Dundee harbour that has come under my notice is the annexed, which is extracted from Smeaton's Reports, vol. iii., p. 54, edit. 1812, to which I beg to refer.

The harbour was then about 4½ acres in extent, with protection piers on the east and west, and two insulated breakwaters on the south or sea side, which formed one principal and two narrow entrances on that side.

There was likewise a small basin of about one-third of an acre for penning up the sea-water for the purpose of scouring out the harbour by means of sluices; but the Tay brings down with it a great deal of mud, which is deposited and accumulates rapidly wherever there is still water; and the sluices do not seem to have been adequate to keep the harbour clear.

APPENDIX C.

DUNDEE.

No. 141.
Leslie, on the progress of improvements in the Harbour.

Mr. Smeaton, who was consulted for a remedy, recommended that the sluices should be increased both in size and number; and that 6 tunnels should be formed in the west pier and one in the east in addition to one already existing there, for the purpose of allowing the current of the tide to flow through the harbour and assist in keeping it clear. The date of this Report is not given, but most probably it was about the year 1770. The recommendation was but partially complied with, as only one arch of about 20 feet wide was constructed on the west; but there were two arches in addition to the old one formed on the east.

From a plan of the town and harbour, published in 1793, it appears that the harbour remained in nearly the same state up to that time, except that a pier of 180 feet in length had been built in 1788 from the extremity of the eastern side pier and pointing towards the east, or nearly parallel with the beach, so as to form a new harbour within it, and considerable embankments had been made into the river in the vicinity of the harbour for timber and ship-building yards, partly by the Town Council, but chiefly by private individuals. An insulated breakwater was built in 1803 upon a rock in the direction of the outer pier last-mentioned (see No. 3), so as to give additional shelter to the new harbour, and a private dry dock was built in 1812, considerable further progress having been made by that time in extending the adjoining properties towards the river.

The shipping having increased considerably by this time, a want of better accommodation began to be felt, and plans were furnished by Mr. Telford and Mr. Stevenson for forming a wet dock, and otherwise improving the harbour. Eventually the second design by Mr. Telford was adopted (see drawing No. 3), and an Act was obtained in 1815 for carrying it into execution, with power to borrow money, and levy dues according to a new scale. The duration of the Act was for 15 years, and it constituted a commission to manage the affairs of the harbour, which until then had been in the hands of the Corporation.

The first estimate was 70,440*l.* for constructing a wet dock of 6¼ acres, with a small entrance tide harbour and a graving-dock. This plan seems to have contemplated the alternative of leaving the outer protection walls unbuilt, as well as the entrance lock, in which case the area of the dock would have remained as a tide harbour. The first work that was done under the Act was in building a new quay on the north side of the old harbour, and filling up the scouring basin. This was commenced in August 1815.

Mr. Raffield was the first resident engineer, and he was succeeded in July, 1816, by Mr. David Logan, now engineer to the Clyde Navigation Trustees.

The next work consisted in building the walls on the north and east of the dock, the eastern outer quay-wall, and the west protection wall, and in constructing the graving-dock.

The west protection wall was completed in 1820. It consisted of a rough building 12 feet wide at the top and about 24 feet in height, with a batter of 2 inches per foot.

The outside was formed of ashlar-stones set on edge, and inclining from the perpendicular at an angle of about 30°, being about 18 inches on the beds, hammer dressed, and without any mortar, and the hearting was filled up with quarry rubbish. The outer head, which still exists, was built of good ashlar in dovetailed courses, similar to the masonry of the Bell Rock Lighthouse.

Before this wall had been commenced it was resolved to alter the original plan so far as to carry the protection wall to seaward of the old harbour, in order to enclose it, and thereby give better shelter and berthage; and for this and other purposes another Act was procured in 1819.

The outer arm of the east protection wall, which was built in 1822, was made similar to the last described, except that it was 23 feet, with a greater diameter, and the head of proportionally greater diameter.

The west side of the old harbour was rebuilt of rough masonry, but the east side was formed of a good quay-wall.

All the walls of the harbour, and those surrounding the proposed dock, having been built, and the space behind filled in with mud, the water was excluded from the dock by means of a stone coffer-dam in the winter of 1824-5, and the area of the dock was then excavated, the masonry of the locks built, and the gates hung, and the dock was opened in November, 1825. The lock is 45 feet in width and 170 feet in length between the gates, and the depth of water is from 10½ to 17½ feet.

Mr. Telford's estimate in 1814 was	£70,440
His additional ditto in 1829	6,474
	£76,914

The gross sum expended by the Commissioners in the execution of the work was 120,466*l.*, but of this there was, not included in the estimate, for the purchase of a dredging machine and apparatus, 3450*l.*; for property, 8462*l.*; purchase of Lochee quarry and tools, 2250*l.*; building great common sewer along Dock-street, 2383*l.*; for rebuilding the west wall of the dock, instead of allowing the old wall to remain, 2205*l.*; for constructing the upper part of the east protection wall in a more substantial form, so as to serve as a quay, 1205*l.*; interest of money, 15,225*l.*; enlarging the graving-dock, salaries, expense of collection, 300*l.* per annum, of compensation to the town, &c. &c.: so that on the whole the cost of the works did not exceed the estimate.

There was, moreover, a large piece of ground acquired from the sea, the value of which, in 1825, was reckoned at 7000*l.*, and I believe it is now worth double that sum.

The purchase of the quarry, which was recommended by Mr. Telford, has turned out a very advantageous investment, and commands a supply of stone on moderate terms from other quarries.

To explain the reason for extending the harbour and docks so far into the sea instead of excavating them out of the land, as is done with much propriety in many other places, it is necessary to describe the nature of the locality.

The site of Dundee is a narrow stripe of flat ground, extending from the shore of the Tay to a steep rising ground on the north, which forms a ridge of about 300 feet in height, parallel with and at the distance of a mile from the shore, but at one point reaches the height of 525 feet, forming there the hill called Dundee Law. The town, being thus hemmed in on both sides, can only be increased by creeping alongshore; and being an increasing place, and the property being consequently valuable, it is found to be more profitable to embank into the river than to purchase ground, which is all fully occupied and generally covered with buildings.

Although not strictly connected with the shipping harbour, it may nevertheless be proper to mention

APPENDIX C.

DUNDEE.

No. 141.

Leslie, on the progress of improvements in the Harbour.

that between the years 1823 and 1826 the Craig harbour, belonging to the Tay Ferry Trustees, was constructed, as was likewise Newport pier on the opposite side of the Tay. The plans were by Mr. Telford, and the cost of executing the two was about 22,000*l.* The Craig harbour was sheltered by an insulated breakwater on the east, and has 3 arches 25 feet wide through the west pier to allow the tide to run through.

The harbour remained in the state before described until 1829, when, notwithstanding many predictions when the works were commenced that the dock would never be filled with vessels, it was found that the trade had increased so much that additional accommodation was required for the shipping; and accordingly in that year a plan was made by Mr. Telford and Mr. Jardine for constructing two docks and a tide harbour to the eastward. See drawing No. 8. However, on going to Parliament in 1830, owing to the Standing Orders not having been strictly complied with, it was found that the works could not be carried so far to the east as had been contemplated, and therefore the tide harbour as proposed was given up, and the eastmost dock made to serve as a harbour, and in this shape the Act was passed. See drawing No. 9. Power was likewise taken to convert the old west harbour into a wet dock, although no plan was lodged for that purpose; and it was resolved to proceed first with this part of the works. See drawing No. 9.

The Act of 1830 vested the property of the harbour in a perpetual trust, and authorised the town to claim compensation from the Harbour Trustees, which was finally adjusted by arbitration at 27,500*l.*

The plan and specification of the west dock, now called Earl Grey's Dock, were made by Mr. Gibb, of Aberdeen, in 1831, and examined and approved of by Mr. Telford, and the work was commenced in the autumn of the same year, when a portion of the west wall was built, as likewise a landing-slip for the Ferry Trustees; which, together with a scouring tunnel from the new dock, were given as an equivalent for allowing the space between the breakwater and the shore to be closed up.

No great progress was made, however, until the following summer, when, four new crane-barges having been procured, in addition to the two already employed, the operations proceeded more rapidly. All the walls required to be new except the north and east, and these required about 6 feet of underletting.

The entrance lock was originally intended to be 45 feet in width and 185 feet in length between the gates; but in consequence of two large steamers having been contracted for to run between Dundee and London, it was agreed, upon an application from the Shipping Company, to increase the width of the lock to 55 feet, and the length to 215 feet.

The depth of the entrance and of the whole area of the dock was likewise increased one foot, making the depth of water from 13 to 20 feet, according to the state of the tides. The outer and quay walls, which are founded on rock or clay, having been nearly all built by the beginning of summer, 1833, it was intended to build the lock that year; and preparations had been commenced for excluding the water by constructing a stone coffer-dam across the entrance and erecting a steam-engine and pumps; but it was found that a sufficient supply of sill and invert stones could not be procured in time; and therefore the building of the lock was deferred till another year, and the shipping were re-admitted during the autumn and winter.

It is to be observed that the stone of this district of Forfarshire, which is almost all of a dark grey sandstone, and similar to the Kingoodie or Mylnefield stone, which was used extensively in the building of the London docks, is liable to split with the frost when wet or newly quarried; and, consequently, it is necessary to suspend the quarrying on the approach of winter, or to be very careful in covering up the exposed surface of the rock and the newly quarried stones with spruce-branches.

During the winter the old west protection wall was removed from the interior of the harbour outside of the dock entrance; and by the beginning of April, the area of the dock having been again cleared of vessels, the coffer-dam was begun to be carried up, and the remaining piles driven for supporting the railways for carrying the portable cranes and conveying forward the building materials. See drawing No. 10.

As the bottom of the entrance is rock, and consequently piles could not be driven down into it, the coffer-dam was consequently formed of masonry (fig. 1, drawing No. 10), being two circular walls 4 feet thick, with a space of 5 feet between to contain a puddle of clay, and tied together by iron bolts passing through upright wooden fenders. There were two troughs through the dam 3×2 feet, with sluices for letting out and excluding the water. The foundation of the dam required to be laid like the other walls in wooden portable dams, which were allowed to remain to serve for removing the foundation of the stone building when the dock was finished.

The water was shut out by the middle of April; but as there was a great depth of mud to remove from the entrance, it was the beginning of May before any of the inverts could be laid; and at first the work proceeded slowly, but after the cranes and railways were fairly completed the progress was pretty rapid; and as it was quite necessary that the dock should be opened by the following winter, the work was carried on by double squads by day and night.

The underfooting of the north and east walls was completed by the beginning of August, and the excavation of the dock, which was chiefly mud, but partly also a very hard rock, was completed by the middle of September. The gangways for carting away the stuff from the excavation were then removed, and the gaps in the walls, which had been left for them, were built up.

The taking down of the coffer-dam was immediately commenced, and vessels of small draught of water admitted into the dock; but there was a good deal of difficulty in removing the foundation, which was considerably below low water, and, as before stated, required to be done by means of a wooden dam surrounding it, from which the water required to be pumped each tide, but the whole was removed by the middle of December.

The masonry and excavation of the lock cost about 9000*l.*, and the gates and sluices 3000*l.*; thus making the whole of the lock 12,000*l.* The excavation of the dock cost 2300*l.*, and the whole expense of constructing the dock and entrance lock was as nearly as possible 46,000*l.*, not reckoning the interest of money during the time the work was going on.

Several minor improvements have been effected in Earl Grey's Dock, such as erecting an export shed (see drawing No. 14) on the east side with sliding doors so as to shut quite close, and a large shed over the projecting tongue or quay (drawing No. 15) where the London and Hull steamers lie, and this being shut in with gates at the north end is considered a great convenience.

A branch of the Dundee and Newtyle Railway has also been brought down to the west quay, with

APPENDIX C.

DUNDEE.

No. 141.

Leslie, on the progress of improvements in the Harbour.

offsets close to the dock sides, for discharging coals, &c. into the waggons, and for shipping country produce.

Two or three 4-ton cranes are now being erected on the quays; and it is also intended to be procured immediately a 30-ton crane for lifting the boilers of large steam-vessels. This crane is to be placed on the north side of the entrance lock.

So much advantage had accrued from the possession of Lochee Quarry, that the Trustees purchased a considerable addition to it in 1833. The distance from the harbour is 2½ miles. They also took a lease in 1833 of the Quarry of Pyotdykes, nearly 5 miles distant. A considerable supply of stones has, however, all along been got from Mylnefield, and at about the same cost as from the Harbour Quarry; but during the building of the lock, while there was a difficulty in procuring an adequate supply, coping and invert stones were procured at a higher rate from other quarries at a greater distance.

The operations had not in the mean time been confined to the construction of the western dock. The constantly increasing trade had made it evident that further accommodation would soon be required; and therefore it was resolved in spring 1833 to set about forming part of the projected eastern dock, by building 1000 feet in length of the outer or sea wall, and 600 feet of the south wall of the dock, so that the area included between them, when shut in by a temporary wall across the end, might serve to contain the mud lifted by the dredging machine and the spare stuff excavated from the bottom of the west dock, and would eventually form a piece of valuable ground, while the space inside of it would serve as a tide harbour for small craft, which had come to be much needed in consequence of the old tide harbour on the west being so much curtailed in dimensions by taking the greater part of it to form a dock. The estimate of this work was 18,500*l.*, and a length of 1400 feet of the walls was built by the spring of 1834.

Before these works were commenced, the Trustees had resolved to enlarge the dimensions of the new dock beyond those of the Parliamentary plan, and the position of the south quay-wall was shifted so far to the south as to allow of an entrance being made to the graving-dock from the east at a future time if it should be thought proper to divide it into two; and in order to keep the dock, and the ground to be embanked to the south of it, more nearly of a parallel shape, the eastern end was carried 90 feet farther up the beach, or so far as the Act authorised a deviation from the line laid down.

It was also agreed to remove the outer part of the old east protection wall, as the berthage alongside of it was much exposed to south-westerly gales (see plans 9 and 16), while in the angle formed by the two quay-walls built in lieu of it there is good shelter.

Openings were left in the east wall of the old harbour for two building-slips, and for a repairing-slip on Morton's principle; and to form a foundation for the latter, instead of filling up the space with mud or other soft materials, a great mass of the rubble heart of the old walls was laid down, so as to consolidate before the time that the slip was to be erected.

The removal of the two old protection walls from the area of the harbour was a very difficult and expensive work, as they required to be excavated considerably below low water, so as to level the surface of the harbour; and the long stones set on end to form the foundation of the face buildings were very hard to draw. They, however, served as a sort of cofferdam for excavating the interior; and whenever a space of about 20 feet in length was quite cleared of stones, it was filled up with mud from the dredging machine to displace the water and save pumping.

The laying down of so much mud, and the pumping of the muddy water, caused a considerable deposit in the harbour at that time, and gave rise to a clamour that this was owing to the re-entrant angle in the outer walls caused by preserving the two old heads (see No. 16), and which it was assumed had stopped the current of the tide from running past the mouth of the harbour.

For the sake of symmetry it would have been better that the outer walls had been kept in a straight line, as the two heads, although consisting of good masonry, were scarcely of such value as to be worth any deviation to save them; but at the same time I do not consider that any evil has arisen therefrom beyond merely marring the appearance, for the indentation is too slight to have any perceptible effect upon the current running past the harbour. The ebb-tide certainly runs with less strength along the west part of the outer wall than is desirable; but this is owing to the deep bay on the west of the Craig pier, and to another bay about half a mile farther west, at a place called the Magdalen Yard, which is terminated by a jutting point of rock on the east.

Both of these tend to make the water shoot outwards instead of directing its course close alongshore, and in consequence an ugly bank has formed to the westward of the harbour.

Attention has been drawn to this evil; and I hope that at no very distant time it will be cured by building a wall to the westward from the point of the Craig pier, and embanking the ground enclosed within it from the sea, and also by filling up the bay at the Magdalen Yard, and cutting away the projecting point of rock.

On each side of the entrance to the harbour are situated some low rocks called the Gryces (Anglicè Pigs), which were a considerable obstruction to the shipping, and several vessels have sustained damage by getting aground on them. However, by taking advantage of nearly all the very low tides for several years past for blasting and removing the rocks, they are now nearly all reduced below the level of low water.

After Earl Grey's Dock had been finished, as before mentioned, the whole of the force was put upon the works to the eastward, but, instead of terminating them at the extent first proposed, the Trustees resolved in the spring of 1835 to carry forward the walls so as to enclose the *whole* of the space lying to the south of the dock and entrance lock, and to the west of the new tide harbour, and thereby dispense with the temporory cross-wall. The wall on the south side of the lock is quite rough, being meant merely to retain the mud in the mean time, but to form eventually the *backing* of the lock-wall, the ashlar of which will be tailed into it. The estimated cost of this addition to the first part was 28,500*l.*, and the cost of filling up the ground, which forms an area of nearly 16 acres, was reckoned at 15,000*l.*

All the foundation of the inner wall, and of about 900 feet of the outer wall, was laid in portable cofferdams, of which a drawing is given (No. 17); but on getting to the eastward, where the foundation required to be about 11 feet below low water to get to the hard, as there was no particular necessity for founding the outer wall in this manner, it not being intended to serve as a quay, a different and less expensive mode of founding was adopted. A deep trench was first dug out by the dredging vessel, and a mound of stones and rubbish laid down in the track.

The stones were allowed to remain a considerable time to consolidate, when they were levelled

No. 141.
Leslie, on the progress of improvements in the Harbour

down, and the wall founded on them by a course of long stones set on edge, the lower bed being about a foot below low water of spring tides.

There is some subsidence in this wall after the full weight is on it, and consequently it is necessary to bring it up equally and gradually, and to allow it to stand for some time with the two upper courses laid on loose until it has come to its bearing. For a section of this, as well as of the other harbour-walls, see No. 18.

In order to allow the filling up of the ground to proceed more rapidly, and also to deepen the area of the dock, a new dredging vessel of 16 horse-power was procured in 1835, at a cost of nearly 4000*l.*

The machinery of this dredger was made by Mr. Borrie, of the Tay Foundry, Dundee. It generally lifts about 700 tons of stuff per day, when working two tides.

The plan pursued in embanking is first to fill up the ground from hopper-punts as high as the tide will allow them to discharge, and then to empty the mud with shovels over the side of a common hollow punt until the ground gets nearly as high as the tide, so that the most shallow vessels cannot float over it. The remaining height is then made up by heaving up the mud in cubical boxes by a counter-balance crane, and setting them on a waggon which is run along a temporary railway to the desired place, where the box is capsized and the mud turned out, when the box rights itself again.

These boxes are of plate iron, and hold nearly 20 cubic feet of mud each, which weighs 18 cwt., and there are 27 boxes in a punt. This mud makes excellent puddle, as it runs into every crevice and is quite impervious to water, except what is taken up in places exposed to the wash of the sea, which is more or less sandy, but it weighs very heavy against the walls, being above one and a half times as heavy as water and nearly liquid.

A large quantity of earth and rubbish from foundations of houses in the town is likewise carted down to the harbour, and for this a small sum is paid, as it forms a good solid surface over the mud.

Drawings of the new dredging vessel and of the mud apparatus are given in Nos. 19, 20, and 21.

The walls are now all finished round the space to the south of the dock, and it is more than half filled up.

A large common sewer runs along Dock-street, having communications by sluices with the two docks for the purpose of scouring, and it is the outlet also of a small stream which runs through the town and supplies water to a number of steam-engines along its course.

This sewer discharges into the north-west corner of the new eastern dock, and it became necessary that the water should be conveyed to the eastward past the dock, and discharged into the open harbour.

In 1836, in consequence of the foundations of the quay-walls then in progress being very deep and difficult, it became impossible to get so much founded during the spring tides as to furnish work for the masons in building the upper part of the walls during the neaps; and as the sewer before mentioned did not require to be carried any deeper than merely to get a solid foundation, which at that place was within a foot or two of the surface, it was accordingly resolved to proceed with the building of the sewer, which was of considerable advantage, as it could be founded at very moderate ebbs.

The masonry of the sewer is carried up to the level of the quays so as to carry a boundary-wall (see No. 18), which is to divide the quay from the street, as the new dock is to be completely enclosed instead of being left perfectly open like the other two.

The sewer-wall will be sufficient to retain a bank of mud behind it, which will serve to exclude the tide-water on the north side of the dock after it shall have been shut by the quay-walls, and a cofferdam across the entrance on the east; and, therefore, it has been thought advisable to defer the building of the north quay-wall, which is 70 feet south of the boundary-wall, as likewise the west quay-wall, until the area of the dock shall have been emptied of water, in order that it may be excavated to the proper depth and the entrance lock built, as the founding of these two walls may then be done so much more economically than by tide-work.

In pursuance of this plan the lower part of the sewer has been nearly finished as far as its outlet into the harbour. All the west quay-wall, and two-thirds of the north wall of the entrance harbour, are built, and the east wall of the dock to the north of the entrance is founded; and in this state the works are at the present time, as shown by the plan No. 22.

It being necessary to bring a bill into Parliament in 1836 for power to borrow more money, for establishing a dock police, and for various matters that required amendment, it was thought proper to take that opportunity of acquiring power to extend the works farther than the Act of 1830 permitted, and accordingly the Act of 1836 authorizes the construction of another dock to the east of the new tide harbour, there being thus a lock on either hand on coming into the harbour; but as this dock is not likely to be required for a number of years, a temporary outer wall will be constructed to the east of the tide harbour for its protection, and to give a proper set to the flood-tide.

The estimate framed in March, 1836, was 150,000*l.* for one dock and tide harbour; 230,000*l.* for two docks and tide harbour.

In consequence of an application from a number of the inhabitants of Broughty Ferry for a harbour or landing-place there, power was also taken to build a harbour or jetty for their accommodation, as shown in the Parliamentary plan; but only with the consent of the proprietor of the ground (see Parliamentary plan, No. 23).

Vessels and goods are to pay full shore-dues when the building is erected, instead of, in some cases, only half-dues, as at present; and a sum is also to be levied on passengers, but nothing has hitherto been done in the matter.

The Act gives also authority to construct a landing-place at the Beacon Rock into about 12 feet at low water, and to construct a suspension bridge out to it from the eastern sea-wall; but this project cannot of course be carried into effect until the ground be embanked inside, so as to give an approach to the bridge.

In 1837 a repairing-slip was constructed on the east side of the old harbour on Morton's principle, or as more commonly still called a patent slip. It is calculated for hauling up vessels of 800 tons, and the cradle or moving carriage, which is in three lengths of 95, 35, and 30 feet, is capable, when they are joined together, of taking on a steamer of 170 or 180 feet keel.

The ways extend 200 feet beyond the quay into the harbour, and are 350 feet above the quay into the yard; and three vessels of about 300 tons can be taken up above the bridge. The ways have an inclination of 1 in 18, and go down to the depth of 3 feet below low water of spring tides; and as

APPENDIX C.

DUNDEE.

No. 141.

Leslie, on the progress of improvements in the Harbour.

they rise 8 feet above the ground at the upper end, a roadway is made through below so as not to be interrupted by the chain, and cellars are constructed under the upper part of the slip for holding tar, shipwrights' tools, &c. &c.

The purchase is wrought by a condensing steam-engine of 15-horse power, and made with side levers in the manner of a marine engine, as the crank shaft to which the power is to be applied is above the engine. There are three different motions for the pitch-chains, according to the weight of the vessel to be hauled up, and at the rate of 4, $7\frac{1}{2}$, and 15 feet per minute with the engine going 30 strokes, but a delay of about three minutes takes place at each fluting of the chain, which is in general done every 40 feet, or two lengths of chain-rods; but, in the case of a vessel occupying the top of the slip while another is being hauled up below, it is more convenient to take out one rod at a time of 20 feet.

Any vessel under 500 tons burden is hauled up by a single chain working on a pitch-wheel in the centre line of the slip; but for larger vessels two chains are used working at equal distances off the centre, and connected at the lower end to the carriage by a segment of a circle turning on its centre, so as to make them bear equal strains.

The chain-rods are $2\frac{3}{8}$ inches diameter, having thus an area of 4·43 inches, and the links of the pitch-chain, which are $11\frac{1}{2}$ inches long, have a sectional area of 6 inches. There is a barrel on the third shaft which has four times as quick a motion as the main shaft for the purpose of hauling up the empty carriage after a launch, which is done by a common short-linked $\frac{3}{4}$-inch chain, and this chain and barrel are also used for bringing up any small craft of below 40 tons.

When a vessel has been hauled up to the place where she is wanted, if the keel should require repair or renewal, or if the cradle be wanted for another vessel, then the first is raised up by means of screws, and blocked and shored up in that position until the carriage be replaced again for the purpose of launching her. Any vessel of ordinary weight is allowed to go by the run as in an ordinary launch, but if necessary the carriage can be lowered down to any distance by the steam-engine, so as not to give too great a velocity before entering the water. Three vessels, measuring on the aggregate about 800 tons, have been blocked up off the cradle at one time, and another vessel hauled up below and repaired on the cradle. The keel-blocks are of cast iron, with an opening through for the chains to work in when hauling up another vessel below.

The slip was opened in December last, but several alterations and improvements have been made on it since, and a cast-iron foot swivel-bridge has just been erected across the entrance. The details of the slip are given in drawings Nos. 24, 25, 26, 27, and 28.

It is intended to connect the engine with a saw-mill, &c., for the use of parties using the slip.

The whole expense, including the engine-house, masonry of purchase, &c., was about 9000*l.*; but a great part of this was incurred in bringing up deep foundations for the masonry, and, had the ways been laid, as there is frequently an opportunity of doing, on an open gravel beach, where there is no deep founding required or quay-walls to build, the expense would not have exceeded 6000*l.*

Various opinions are entertained as to the respective merits of the graving-dock and the slip; and I believe that the advantages and disadvantages are pretty nearly balanced; but it will soon be seen which is the favourite here, as they have been opened to the public at precisely the same rate of dues.

The comparatively small expense of the construction of a slip will, however, insure its being extensively used in many places where a graving-dock is beyond the means at disposal.

The chain-rods of the slip were specified to be tested with a strain of 12 tons per square inch, which gave an aggregate of 53 tons on the area of 4·43 inches; and as there was no testing-machine at hand of sufficient power, the plan adopted was to connect a number of the rods together, and, making fast the lower end to a buttress across the lower end of the slip, to apply a strain to the other end by means of the engine and purchase-machinery; and, by calculating the deflection proper to the required tension, and heaving up the chain until it rose to a point at the centre corresponding to that deflection, the proper strain was ascertained to a nicety.

The length between the points of suspension is 380 feet, the weight of the chains 6688 lbs., and the deflection consequently 2 feet 8 inches. Four of the rods broke with the strain, chiefly at the weldings, but all the rest held good.

During last summer the iron gates of Earl Grey's dock were raised up about 7 feet out of their places, so as to have the lower parts examined at low water, to ascertain whether the limnoria had been able to make any entrance between the sheathing.

The gates were suspended by three sets of chains passed round the lower bar, and wrapped round with mats to prevent them hurting the timber, and the lifting was done in the manner shown in drawing No. 29, by using six jack-in-the-box screws belonging to the patent slip, and blocking up the cross-heads under the chains at every shifting of the screws.

In this way in each of four succeeding spring tides one leaf was lifted, scraped, scorched, and tarred, and some additional sheathing put on, and then lowered again into its place within two days after the scaffolding had been erected.

It was found that the worm had commenced its ravages, and that the precaution had been taken just in time to prevent it doing mischief.

The terminus of the Dundee and Arbroath Railway, for which an Act was passed in 1836, is at the N.W. corner of the wet dock now being constructed. The railway was opened last September from Arbroath to within two miles of Dundee, where there commences some heavy cutting and an embankment from the sea.

The embankment now extends up to the eastern side of Carolina Port, which is marked on the plan; and as the Harbour Trustees had by the Act of Parliament the option of constructing and holding possession of that part of the railway which comes within the limits of the former Harbour Act of 1830, viz. to the westward of Carolina Port, they have accordingly resolved to do so, and preparations are being made for commencing the work so soon as the railway company shall have completed their portion so as to allow materials for the embankment to be brought from the deep cuttings to the eastward. In other respects the works which most probably will be done next season are, to found and build a rough wall on the north side of the entrance lock, and to complete the east end wall of the dock so as to allow the space included between it and the tide harbour to be made up, and afterwards to proceed with the walls to the eastward of the tide harbour; and before the new dock can be finished the walls on the south side of the tide harbour will also require to be built, so as to shelter the dock-gates from the easterly sea.

APPENDIX C.

DUNDEE.

No. 141.
Leslie, on the progress of improvements in the Harbour.

Although it be not, strictly speaking, a part of the harbour works, I may nevertheless be permitted to mention farther, that money was voted last Session of Parliament for building a custom-house on the space of ground belonging to the Harbour Trustees, situated on the east side of King William the Fourth's Dock, and fronting towards Dock-street, and that the building will most probably be commenced next spring.

JAMES LESLIE.

1st April, 1845.

No. 142.

No. 142.
Leslie, on operations in the bed of the Tay.

Report by JAMES LESLIE, Esq., C. E., *regarding the operations of* LORD KINNAIRD *and* COLONEL PATERSON *on the Bed of the River Tay.*

Dundee, September 22, 1843.

GENTLEMEN,

I FEEL it my duty to call your attention to the fact, that a long dike is now being built on the north shore of the river Tay, opposite the march between tha properties of Lord Kinnaird and of Colonel Paterson of Castle Huntly.

This dike extends outwards from high-water line, across the north banks of the river, with a view, I presume, to promote the silting up of the shore, and thereby to allow, in time, of a portion of ground being embanked from the tide and rendered arable, in the way that has been done by other proprietors on the north side of the river between that place and the mouth of the Earn.

I do not know what is to be the length of the dike, as the advertisement for tenders, of which a copy is annexed, is expressed in very general terms; but I have reason to believe that it was at one time contemplated to extend it above two-thirds of a mile out from high-water mark, and that even more than double that length had been spoken of, which would have carried it considerably more than half way across the river.

Any encroachment on a tidal river or estuary, by lessening the quantity of its back-water, must diminish the strength of the scour at the lower parts of the river, and must thereby tend to form banks there, and so to injure the navigation; and, therefore, it is of the utmost importance to the interests of the harbour of Dundee, that the estuary of the Tay should not be encroached on, or its capacity diminished, by forming embankments, or by using any other artificial means to promote the silting up of its shores. It may be a question, whether any of the embankments, or other works, that have been already executed, or are now in progress, be of sufficient magnitude or importance to render any interference with them expedient or advisable; but it does seem indispensable that some inquiry should be instituted; for it is very evident that one encroachment leads to others, and that, if they were allowed to go on, without being objected to, they would soon increase to such an extent as to be attended with very injurious consequences.

The Magistrates of Perth, or the Navigation Commissioners, if they do not encourage, seem at all events to take no means to prevent, encroachment on the north shore—their object being, it would appear, to confine the navigable channel, as much as possible, to the south shore; and with that view they lately brought an action, and got a verdict of a jury, for the removal of several dikes or jetties on the property of the Earl of Zetland, between Flisk and Newburgh.

Now, the narrowing of the river may be of advantage to the navigation between Perth and Dundee, and more especially between Perth and Newburgh, but it is decidedly injurious to the navigation at and below Dundee; and the long dikes extending outwards from the north shore are especially hurtful to Dundee, by throwing the strength of the current over to the south side of the river, to which there is already too great a tendency without its being increased by artificial means.

I have &c ,
JAMES LESLIE.

(*Advertisement referred to.*)

Contractors wanted to build a Sea-Wall at Polgavie. Apply to James M'Laren, at Castlehill, betwixt and the 24th current.—*Castlehill, May* 10, 1843.—(From *Advertiser* of 12th and 19th *May*.) ,

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Dundee, October 16, 1843.

GENTLEMEN,

AGREEABLY to the instructions given in your minute of the 4th instant, I last week, accompanied by Mr. Milne, visited and examined the dike now being built on the north shore of the Tay, opposite the march between the properties of Lord Kinnaird and Colonel Paterson of Castle Huntly.

I measured and took the bearings of the dike, and have laid it down on the accompanying plan.

The foundation is laid to the extent of 3110 feet, or ⅗ of a mile, out from high-water mark, and in a direction bearing S. by E. by compass. The building is completed to the length of 410 feet; at which distance the top, which is about level with high-water of spring-tides, is 8½ feet above the surface of the mud. A farther length of 917 feet is raised to about half its height, or from 4 to 6 feet; and the remaining portion, which is founded, is about a foot or 18 inches in height above the surface of the mud.

I have no information as to whether it be intended to carry out the building beyond the length already founded. There are no stones laid down beyond that distance to indicate any immediate intention of proceeding farther; but the stones at the end are not laid as if they were to form a permanent finish to the building. The length founded is exactly ⅗ of the whole width of the river. The surface of the mud-bank at the outer end is from 10 to 12 feet below the level of high-water of spring-tides; and the outer end of the dike will, accordingly, if carried up to the same level as tha inner end, be 10 or 12 feet in height. Considerable works were executed several years ago by Lord Kinnaird with the view of gaining land to the westward of the march dike herein spoken of, and extending along the shore about a mile and a third, to Powgavie, where there is a small shipping harbour. These consisted chiefly of wickerwork fences, both at right angles and parallel with the shore, so as to intersect each other, and one running obliquely along the east side of the Pow. The plan shows the state of these two years ago; but considerable additions have been made, both to their number and their lengths, since that time; and just now, in some places, sub-

APPENDIX C.

DUNDEE.

No. 142.

Leslie, on operations in the bed of the Tay.

stantial stone dikes are being substituted for the wickerwork;—in particular, for that fence which runs out at right angles with the shore to join the one running obliquely along the side of the Pow, and which, at the junction, extends about as far out from the land as the present end of the foundation of the march dike.

The area that would be enclosed between the march dike on the east, and the fence along the east side of the Pow on the west, supposing them not to be extended beyond their present lengths, would be 340 acres; but the effect in causing a silting up would be very great, both above and below these works, as well as upon the shore opposite the property of Lord Kinnaird.

The plan shows also the long dikes that have been at various times built on the estates of Seaside and of Errol.

I have &c.,
JAMES LESLIE.

Further Statement prepared for the purpose of being submitted to Counsel.

FROM the bar or mouth of the river Tay to Dundee, a distance of 11 miles, the width at low-water varies from three-quarters of a mile to about a mile and three-quarters; and the narrowest place, viz. at Broughty Ferry, is nearly a mile in width at high-water.

Between Dundee and the confluence of the Tay and the Earn, a distance of 15 miles, the width of the estuary at high-water varies from 3 miles at Invergowrie Bay to $1\frac{1}{4}$ mile at Newburgh, and to $\frac{5}{8}$ of a mile above Mugdrum Island, immediately below the mouth of the Earn; and the area is about 17,800 acres, or $27\frac{3}{4}$ square miles. Of this area, about four-sevenths are dry at low-water of spring-tides—the remaining three-sevenths being under the level of low-water, or occupied by the fresh-water channel of the river.

The waters of the Tay and the Earn bring down with them a great quantity of alluvial matter, more especially during freshes; and there is, consequently, a very great tendency to deposit the matter held in suspension, wherever the velocity of the current is diminished by the river widening out into an estuary, and by its meeting the tidal waters of the ocean.

The sand and other heavy matter is frequently deposited in large quantities, even in midchannel, wherever there is an eddy, or where the current has not sufficient strength to sweep it along; while the mud and other lighter particles can only settle down to the bottom in those places where there is neither much current nor wave; or, if it do settle down in an exposed situation during quiet weather, it is liable to be washed up again by the first jabble of a sea that breaks over it; but in perfectly sheltered situations, where there is no current, the deposit is extremely rapid.

The navigation at and below Dundee is kept open solely by the rush of the tidal waters into and out of the estuary being sufficiently strong to sweep away the sand brought down by the river; for the mere fresh water of the river alone would never suffice to keep down the bar, and otherwise to maintain the depth necessary for the lower navigation.

The channel of the united rivers above Mugdrum does not exceed 700 feet in width at low-water, or one-sixth of the width at the strait of Broughty Ferry; and except during freshes, neither the depth nor the velocity is very great.

It is evident, therefore, that the body of water which finds an easy passage through this confined channel would be of itself quite insufficient to serve as a scour to the mouth of the river; and that it is, consequently, of the utmost importance to maintain the full strength of the tidal current; and for that purpose to preserve entire the size and capacity of the estuary, and not to allow it to be encroached upon by artificial means.

Not many years ago, the Tay, after being joined by the Earn, used to run so strongly along the north shore, as to undermine and endanger the land; and a wall was required to be built along the foot of the water braes for their protection.

A late proprietor of the estate of Errol, seeing the difficulty and expense of keeping up these parallel dikes, altered the system to that of projecting dikes at right angles out from the shore; and these soon caused such a deposit of mud or sleek in the eddies produced by them, that a large space of land has been gained from the shore where there was formerly deep water; and the parallel dikes, which were formerly so indispensable, have been lifted to form embankments a long way farther out.

These cross dikes have been extended farther of late years, and one of them is now 1800 feet long.

This plan, being found so efficacious both for the protection and the acquisition of land, has been adopted by many of the neighbouring proprietors—viz. by Sir John Richardson of Pitfour, Lord Kinnaird, and Mr. Hunter of Seaside on the north shore; by Mr. Hay of Mugdrum on the north side of Mugdrum Island; and by Mr. Paterson of Carpow, and the predecessors of the Earl of Zetland, on the south shore.

The Magistrates of Perth, or the River Commissioners, have taken no steps to prevent encroachments on the north shore, or on the north side of Mugdrum Island, but rather seem to have encouraged them. They, however, lately brought an action against Lord Zetland to compel the removal of the dikes on his estate of Balmbriech, below Newburgh, on the ground that they formed sandbanks and impeded the navigation; although some of them had stood for about forty years, and the longest of them was not one-fourth part of the length of some of those on the north shore; and although, in consequence of the increased strength of the current along the south shore, caused by the partial shutting up of the channel north of Mugdrum, the land on the south shore was washing away and stood much in need of protection.

The case came to a jury trial; and ultimately Lord Zetland's legal advisers gave up their case without making any defence; and the whole of the dikes upon the estate libelled, which included all that were of any value, required to be pulled down and removed.

It appears, therefore, that it is the object of the Perth authorities to narrow the river, and to confine it as much as possible to the south shore; and that consequently the Trustees of Dundee Harbour need not trust to them for attending to the interests of the lower navigation.

It is, indeed, evident that there can be no community of interests in the matter. The navigation between Dundee and Perth, but more especially between Newburgh and Perth, is very shallow, and only available for a very small class of vessels.

It would be an object to get a few feet more depth of water; but the very most that can be got there must be much less than the depth at and below Dundee, even supposing that it were diminished

No. 142.
Leslie, on operations in the bed of the Tay.

considerably within what it is at present. It is, therefore, for the interest of the people of Perth to narrow the estuary as nearly as possible to the width required for the passage of the river water, so that the channel might thereby be scoured proportionally deep; and the ulterior effects on the lower navigation are to them of comparatively little importance.

As regards Dundee, however, the case is very different. The trade of Dundee is carried on chiefly in large vessels, and a sum of 400,000*l.* has been expended in the construction of harbours and docks with sufficient depth for the accommodation of these vessels, which would in a great measure be lost if the lower navigation were allowed to be interrupted by shoals and sandbanks; and shoals would inevitably arise there, if the influx and reflux of the tide were stopped or materially lessened by the silting up of the estuary.

The Trustees of the harbour of Dundee, having, therefore, decidedly a beneficial interest in the tidal scour at and below Dundee, are undoubtedly entitled to interfere for the purpose of preventing the strength of the scour being lessened; and for that end to resist any encroachment on the estuary of the Tay, more especially these projections from the north shore which have a tendency to throw the strength of the current over to the south shore, and thereby to cause slack water in front of the harbour.

The property of Lord Kinnaird is situated on the north shore of the Tay, from 6 to 7¼ miles above Dundee. The estuary is 2¼ miles wide at high-water opposite the east boundary, and 2 miles opposite the west boundary of the estate; and the mud-bank out to low-water is fully a mile and a half broad. Several years ago, a number of wicker-work fences were constructed by Lord Kinnaird, extending across the bank, chiefly at right angles with the shore, but some also parallel with the shore, and intersecting the former; and one running obliquely along the east side of the Pow, a stream which runs into the river between his lordship's property and that of Mr. Hunter of Seaside, at the small shipping harbour of Powgavie. The Pow, instead of running directly across the bank, slants alongshore to the eastward, so much that at the distance of four-fifths of a mile from Lord Kinnaird's west march it is only three-fifths of a mile out from the land. The object of these works seems to have been to prevent the Pow from pushing its channel more to the eastward; but they were no doubt also undertaken with the view of acquiring land; and accordingly a great silting has taken place in consequence of them.

The work now more immediately referred to is a dike which was commenced about the month of May last, upon the shore opposite the march between the properties of Lord Kinnaird and Colonel Paterson of Castle Huntly.

The foundation of it is laid to the extent of 3110 feet, or four-sevenths of a mile, out from high-water mark and nearly at right angles with the shore; and a length of 410 feet of it is finished, and on a level with high water of spring tides. It is not known whether it be the present intention to carry out the building farther than the foundation is laid; but undoubtedly it was at one time in contemplation to extend it farther; and the outer end of the foundation does not show anything like a permanent finish. The length founded is exactly $\frac{2}{7}$ of the whole high-water width of the river at that place; and the surface where the outer end stands is covered to the depth of 10 or 12 feet at high-water of spring-tides.

Lord Kinnaird has been lately extending and increasing the number of the wickerwork fences, and rendering them more permanent by packing them with stones; and for some of them he is now substituting substantial stone dikes; amongst others, for a fence of 2780 feet long, which extends directly out from high-water to join the oblique fence along the east side of the Pow.

The area that would be enclosed by joining the outer ends of the fence last mentioned, and of the new march dike between the properties of Lord Kinnaird and Colonel Paterson, would be 340 acres; but the effect that would be produced by these works in causing a silting, both above and below, as well as upon the property of Lord Kinnaird, would also be very great.

Supposing a line to be drawn to connect the extreme ends of all the dikes, or other projections as they now stand, or are founded, on the north shore and on the north side of Mugdrum Island, as far up as the confluence of the Tay and the Earn, and supposing the space affected by the lowermost dike,—viz. that between Lord Kinnaird's property and Castle Huntly—to trail off to Monorgan Point, the nearest headland on the east, at the distance of about a mile; the area that would be included within the line just described would be 1920 acres, or three square miles, which is equal to about one-ninth part of the whole estuary of the Tay between Dundee and the mouth of the Earn.

The area of 1920 acres here mentioned includes about 70 acres embanked within these seven years, and rendered arable, opposite the estate of Errol, besides considerable spaces silted up between the dikes, and covered with reeds and salt grass on the north side of Mugdrum, and elsewhere, but is exclusive of a great extent of ground embanked by Sir John Richardson opposite the mouth of the Earn, as I have no proper data for the measurement of that space of ground.

It is impossible to calculate, without having sections of the shores, what is the quantity of water that has been or would be excluded by these embankments and other works, as it does not increase in the same ratio as the area embanked or silted up, but depends as much upon the levels of the ground. It is evident, however, that since some of these works stand on ground which is covered to the depth of 10 or 12 feet at high-water, the quantity of water that would eventually be excluded by them would be so great as to have a decided influence on the strength of the scour at the lower parts of the river.

The accompanying plan shows the state of all the works herein described in the summer of 1841, and also the new dike now building by Lord Kinnaird and Colonel Paterson, so far as it is founded; but it does not show the other dikes and fences constructed within these two years by Lord Kinnaird.

If the works before described be allowed to proceed and to remain without challenge, there is little doubt that similar works will be attempted on the north shore, still farther down; where, besides their injurious tendency, in common with the others, in diminishing the size of the estuary, their direct action will, from their vicinity to Dundee, be more immediately felt, in throwing the current still more strongly over to the south shore, to which it has too great a tendency already, and thereby in lessening the strength of the tide along the outside of the harbour.

JAMES LESLIE.

Dundee, October 24, 1843.

APPENDIX C.

DUNDEE.

No. 142.
Leslie, on operations in the bed of the Tay.

Abstract of the Foregoing Statement.

Mouth of the river Tay to Dundee, 11 miles.
Widths at low water, $1\frac{1}{4}$ to $\frac{3}{4}$ mile.
Ditto at Broughty Ferry at high water, nearly a mile.
Dundee to Earn mouth, 15 miles.
Widths at high-water—3 miles at Invergowrie Bay; $2\frac{1}{4}$ miles at the east boundary, and 2 miles at the west boundary of Lord Kinnaird's estate; $1\frac{1}{2}$ mile at Newburgh; $\frac{5}{8}$ mile above Mugdrum.
Width at low water at the narrowest—viz. below the mouth of the Earn, 700 feet—$\frac{1}{7}$ mile.
Area of estuary from Dundee to Earn mouth, 17,800 acres, or $27\frac{3}{4}$ square miles, whereof $\frac{4}{5}$ dry at low water.
Lord Kinnaird's estate above Dundee, 6 to $7\frac{1}{2}$ miles.
Length of new dike between Lord Kinnaird and Colonel Paterson, 3110 feet.
Length of Lord Kinnaird's longest wicker-work fence, 2780 feet.
Area beween the fence, along the side of the Pow, and the new dike, 340 acres.
Longest dike, opposite Errol estate, 1800 feet.
Area that would be included within a line drawn to connect the outer ends of all the jetties and Monorgan Point, 1920 acres, or 3 square miles—equal to one-ninth of the whole estuary between the mouth of the Earn and Dundee.

J. L.

No. 143.
Leslie, on a Dike and Cairn below South Ferry.

No. 143.

Report by JAMES LESLIE, Esq., *on a Dike and Cairn below the South Ferry.*

GENTLEMEN, *Dundee, May* 17, 1844.

AGREEABLY to instructions I went this morning at low-water to examine a dike said to be building below Ferry-port-on-Craig. There is no building going on there just now. There is an old dike a little below the pier or harbour, extending about 320 yards out from high-water, with a return-head, pointing upwards, of about 25 yards in length. This wall is level with the beach at the inner end, and about seven feet in height at the outer end, and, from what I could learn, was erected a good many years ago, for some purpose connected with the salmon-fishing.

It is a decided encroachment upon the river, but, as the bank extends considerably beyond the outer end, it does not seem to be much, if at all, in the way of the shipping passing up and down the river.

About 180 yards farther out there is a fishing cairn, of about $4\frac{1}{2}$ feet in height and 120 yards in length, lying in a direction pointing to the lodge where the railway crosses the ferry-road below Craigie.

This cairn is at the outside of the bank, and is two-sevenths of the whole width across to Broughty Castle, out from high-water; and I consider it to be dangerous to the shipping, and otherwise injurious to the navigation.

It is not new, but I understand that the fishermen are in the practice of bringing stones in their boats and laying them down to heighten and widen the cairn, so as to get longer tides for hauling up their nets.

There seems to be another cairn farther down the river, but I had not time to go so far. The annexed sketch will show nearly the position and shape of the dike and cairn; but, until a correct plan be made of the shore, they cannot be laid down with any degree of accuracy. This survey I propose having made some time during the summer; and until then I shall reserve any decided opinion as to the dike next the shore; but, without waiting for any more minute survey, I have no hesitation in giving an opinion that the outer cairn is objectionable, and ought to be removed.

I have, &c.,
JAMES LESLIE.

The Trustees of the Harbour of Dundee.

No. 144.
Blackadder, on the operations in the Tideway at Powgavie.

No. 144.

Report by WM. BLACKADDER, Esq., C.E., *relative to the effects upon the scour at Dundee by the operations in the Tideway at Powgavie.*

Glammis, June 5, 1844.

IT appears by the old charts of the estuary of the Tay, that considerable changes have taken place within the last century and a half, being about the date of the oldest of authentic authority the reporter has been able to procure a sight of.

In particular a great change in the main channel in its central portions, and a great extension of the sandbanks downwards, towards and opposite to Dundee, with considerable degradation in progress along the margins of the carse, from Invergowrie Bay upwards beyond Powgavie, and with which the geological proofs are quite in accordance, and which also go to prove that such had been in progress, from a very remote era, prior to the date of these charts.

And it would thus appear that, while the solum of the estuary was widening or extending in its surface area, its central and deeper portions were shoaling, by the scour becoming less energetic and effective, the natural consequence of the greater spread and less depth of water.

About that period the direction also of the main channel was much more favourable for the scour opposite Dundee than in more recent times, and by consequence the lower banks appear to have been nearly altogether formed subsequently.

The ordinary conception of the formation of the carse of Gowrie is liable to lead to a wrong impression as to the nature of the increase of these banks, namely, as if they had been a mere extension of the self-same geological character as the carse itself, and the gradual upfilling of the estuary by physical causes of the same kind yet progressing which had never been arrested, which is quite erroneous.

Appendix C.

Dundee.

No. 144.

Blackadder, on the operations in the Tideway at Powgavie.

The carse, clay, sands, and other concomitant beds, being a deposit totally different from anything presently in progress, belonging to a more remote era, prior to the existing state of the physical causes now in action, in a similar way as the still older beds of tills and gravels on which they rest, and which protrude in all directions, forming the Inches, had been anterior to the carse for formation itself and the effects of a different and prior action.

Subsequent to the emergence of the carse, or to its having become dry ground, very extensive degradations and encroachments have taken place along its margins by the action of the volume of waters which bound it, as apparent by their shape and other concomitant circumstances, as well as by the traditional accounts and analogous examples presently in progress of a similar kind in other estuaries, and all corroborated and placed beyond doubt by the remains of the original carse beds which can be traced to a great distance within the estuary, there being a very obvious specific difference between them and the more recent deposits, resulting partly from their ruins intermixed with fresh alluvia, and in all probability now constitute, in a less unaltered state, the substrata on which much of the recent and subsequent accumulations of alluvia presently rest, and which have had their origin primarily from the erosive effects on these soft original beds, and that in much greater degree than from fresh drift carried into it from other directions with which they are intermixed, and at some places overlaid.

From the immense volume of the waters which enters at the head from the uplands, the power of the scour had been much more energetic at the period when the limits of the estuary had been more confined, and by various circumstances it may be inferred that the present deposits had only begun to accumulate in an extensive manner when by the erosive effects along the margins the area had become so extended as seriously to diminish the energy of the scour; and the fact of the denudatory action of the waters having nearly altogether ceased in recent times shows the change which has taken place in the nature and diminished power of the scour.

Thus an extensive denudation of the original carse beds, and by consequence the increased surface area of the estuary and its lessened depth of water along its original solum, by subsequent deposits, inferring a lessened power of scour, are all concomitant circumstances most striking and obvious to those versant in the principles bearing on matters of the kind, and, in all probability, also a lessened indraught of tidal waters; for be it particularly observed, that, while its surface area had been widening out internally by the erosive effects of the water on the margins of the soft carse formation, the inlet at the gorge of Broughty being through solid rock, and by consequence remaining practically unaltered, in so far as to permit of an easier ingress to the water to cover such an enlarged shallow surface area, when arising above its level, the extensive shoaling of the original deeper portion within the interior basin not only obstructs its influx, but shuts it out altogether from these deeper portions, in so far as thus upfilled with recent deposits; it being well known that the sea-water runs in along the bottom, the mixed or brackish keeping on the surface.

And as this shoaling appears by the old charts, and is borne out by other circumstances, to have mainly taken place subsequent to the extension of the surface area, and comparatively in recent times, and is very obviously yet progressing, the inference is that, in whatever degree the estuary were to be restored, or made to approximate its former surface area, where the denudations have taken place, it would in an equal ratio be possible to restore its former power of scour, or at all events to arrest the progress of the shoaling at particular places, and also to direct the scour so as to make it more powerful where required, such as for the purposes of Dundee.

Independent of the physical causes bearing on this particular estuary, it may be observed, that in the case of any estuary whatever of some such similar shape, and other circumstances, as that of the Tay, it would not only be quite unscientific, but also contrary to experience, to maintain that the natural shape, thus so liable to change, was always to be exactly such, so as to be the most perfect for its internal scour, and that it was impossible to guide and direct its power better by any artificial means whatever, and that therefore it was fraught with danger to make any change, and that more particularly if by such a change the volume of tidal water was to be lessened; and as this last argument is held in such force by many to be so universal in its effects, the reporter has to observe, that the circumstances attendant on the particular kind of estuaries, such as that of the Tay, that in their central portions they seldom fill up level with water, as might be expected by what has been above noticed, and such has actually been determined to be the fact with the Tay itself by Mr. Jardine, as appears by his accurate section, which has been examined by the reporter, and by which it appears that its medium depression between Broughty and Newburgh is 15 inches below that of the tidal water at its confluence.

The reporter having been engaged in a case somewhat similar, where there was a depression at high-water in the surface of the estuary below that of the outer tideway, and where a portion had been embanked from off the margin of the estuary, and which having become a subject of challenge by Harbour Trustees, on the principle of the exclusion of water, which was alleged by them, and not admitted by the other party founding on this speciality.

The reporter, thereafter having found an opportunity, had the point thus at issue submitted to a person, not an engineer, but of higher attainments in physical and mathematical science than the professional avocations of engineers in general permit of them to acquire, who, after having considered the question, gave it as his opinion there could be no sensible exclusion of water when the internal estuary did not fill up level with the external tideway at high-water; and the reporter has now to state that the case of the Tay is of a similar nature, and he believes that few engineers will dispute Mr. Jardine's accuracy as to the fact.

But even in estuaries in which, by their different shape and other circumstances, the exclusion of water becomes the actual consequence of embankments along their margins, the effects on the scour have, in various cases, been found to be the reverse of what has been so frequently supposed to be so universal by engineers.

Such has been the case at Aberdeen, against some embanking at which various eminent engineers gave their opinion; but latterly, in the face of these opinions, some operations of the kind were made, which, notwithstanding they evidently excluded the ingress of tidal water, have had the practical effect of increasing the scour. The same has taken place by some operations at Lynn with like good effects, and which operations were long opposed in consequence of opinions of some engineers given against them.

The embankments in the upper portions of the estuary of the Forth have never yet been made a subject of complaint, and have been in progress for nearly a century.

APPENDIX C.

DUNDEE.

No. 144.
Blackadder, on the operations in the Tideway at Powgavie.

And the extensive embankments on the Clyde, which have been watched with so much jealousy by the trustees of the lower ports in that estuary, have had no injurious effect on their scour; while it is admitted that the volume of water has been diminished, but has thus evidently become more energetic by being regulated.

And the same admits of being effected in the Tay, in so far as the general question of its scour is concerned, and made much more effective in the particular case of Dundee; for unless some artificial means be resorted to for the improvement of the scour at that place, of a much more extensive nature than anything hitherto proposed, the great probability is, that the physical action, which has in comparatively recent times made such changes, will still continue to operate, and may become even much more injurious than hitherto. by progressing more rapidly.

Such means consist of a judicious mode of marginal embankments, cutting off all the sinuosities, and so as when completed to form a continuous range, calculated by their position and form of outline to direct a more efficient scour, to sweep and maintain a clear channel past Dundee, as in former times; and thus to regulate the operations of nature, and direct them more efficiently for that particular purpose, and not leave them, ad libitum, for their chance effects, as hitherto.

It is quite possible, and also in various cases perhaps the most advisable, for the mere purpose of recovering a portion of the surface which has been so extensively destroyed, that the line of the embankments be made adverse for the purposes of the particular scour at Dundee.

There has nothing however of the kind as yet taken place by the operations at Powgavie, and, if not extended hereafter too much to within the tideway, will, in so far as they go, be conducive for the purposes of that scour, and which admits of being so well followed up by a proper outward line being given to them, and continued by the proprietors easterly toward Invergowrie Bay, to concentrate the force and power of the scour, and direct it with the greatest possible efficiency for the purposes of Dundee, instead of being divided and much reflected away from it as at present.

And while it thus admits of being made so efficient for Dundee, it may be observed, that every measure of this kind can also be made favourable for Perth, as well as all the upper ports in the estuary; and without some such measure of the kind they do not admit of being improved; and therefore, looking to the great public interest involved in the question, it is of too much importance to the community at large to have such operations interfered with to the extent of their total prevention by the mere opinion of engineers, however respectable, for they can scarcely be more so than those who give opinions against the embankments at the Dee, at Lynn, Clyde, and elsewhere, which have turned out to be erroneous.

But in the event of interference founded on such opinions, for the purpose of entire prevention, the reporter would recommend not to submit to it; and if the present bearing of the law is also favourable to such views, then it is full time to apply to the legislature to have it altered, as the real state of the case, on the principles of equity, requires it.

And in which not only the whole of the proprietors adjoining the estuary are interested, but also the whole of the public connected with its different ports, and from which the reporter does not even except that of Dundee itself, notwithstanding the different opinions which are entertained by some individuals interested in that port, who he understands are meditating measures which will be conducive to, and hasten, the very effects which are intended by them to prevent.

There are indications of other physical actions connected with the scour than those herein adverted to by the reporter, likewise adverse to the views thus entertained in Dundee on the subject, the notice of which he has deferred until the observations are completed, which necessarily from their nature require a period of time to have satisfactorily made; and, looking to the whole case, he considers that it cannot be too strongly impressed on that portion of the public interested, that, while some of the works and operations within the last 30 years at Dundee are of a very questionable nature as to the effects on the particular scour at that place, this principle of intended interference by the Harbour Trustees with others, upon whatever footing they choose to found it, strikes at the root of every improvement, not only of the navigation in general, but that also of every other port in the estuary.

WILLIAM BLACKADDER.

No. 145.
Opinion on limits of Trustees' jurisdiction.

No. 145.

Queries and Opinion of Counsel as to the Limits of the Jurisdiction of the Harbour Trustees.

Query 1. Whether, by their rights and infeftment, and Acts of Parliament, the Memorialists (the Dundee Harbour Trustees) are entitled to levy dues on the tonnage and cargoes of all vessels which shall beach or load or unload on the shore within the precincts of the harbour of Dundee, on the south side of the river Tay, from Balmerino on the west to Drumla sands on the east; or, which shall load or discharge their cargoes at the respective ports or ferry-stations of Ferry-port-on-Craig, Newport, Woodhaven, and Balmerino, or any of them?

Answer. We are clearly of opinion that the right of the Memorialists to levy dues on the south side of the Tay is not lost by dereliction.

The precincts of the harbour very clearly extend along the south shore of the Tay, and, although dues may not hitherto have been levied on that side of the river, the right to make the levy, when it becomes expedient to do so, is not lost. The whole right is preserved by the levy of dues, under the grants in favour of the Memorialists' authors and themselves, on the south shore. If it were otherwise, right of immunity would be established within the limits of almost every harbour, for there are very often places within the precincts where dues have not been collected, either because the levy would have been more costly than the receipts, or from other causes. The principle seems to be quite settled by the case of Scott, 14 Shaw.

The only way in which the right, as it appears to us, can be lost to the Memorialists, is by a grant from the crown of port and harbour, with a right to levy dues, followed by possession on the part of the grantee for 40 years.

The right of port and harbour is inter-regalia; and a grant from the crown seems to be necessary as a title for prescription. In the absence of such a grant followed by prescriptive possession, it seems to us that the title of the Memorialists must prevail.

Appendix C.

Dundee.

No. 145.
Opinion on limits of Trustees' jurisdiction

In so far as relates to any competing right on the part of the proprietors of Ferry-port-on-Craig, it appears to us, from the excerpt from the title given in the Memorial, that these titles contain no grant of free port or harbour. The grants seem to us to be a grant of a right of ferry only with the necessary appendages to such a right. We do not think that the proprietor could, under that title, levy harbour-dues from a vessel not engaged in ferrying. We think that the rights of the Memorialists extend over the shore adjacent to Ferry-port-on-Craig, and that they are entitled to vindicate their right of harbour, and of exacting dues from vessels repairing to that place, or anchoring and discharging goods at the quays or along the shore.

The title of Mr. Berry is more ample, although it seems of recent date, and to have been disregarded in the question with the town council and other parties interested in the ferry. It appears that the grant of free port, anchorage-dues, &c., was for the first time introduced in a crown charter in 1819, and the right seems to have been so introduced *per obreptionem.* It would be desirable to know how far dues have been, in point of fact, levied at Newport. If not, the case would seem to be plain enough; but even if there had been a use of levying dues since 1819, which we do not presume, we think that the Memorialists must succeed in any question with Mr. Berry.

Our information is not sufficient to enable us to offer any opinion as to the right of the proprietor of Woodhaven. An inquiry into the facts with reference to the exaction of dues at that place should be instituted.

Although a right to exact barbour-dues cannot, as it appears to us, be constituted otherwise than by a grant from the crown, or Act of the Legislature, we think that proprietors within the precincts may prescribe by possession for 40 years, free from the exaction of dues, an immunity from such payment with respect to vessels loaded with commodities for the exclusive use of themselves or their tenants.

Query 2. Whether in the case of vessels with cargoes coming into the river Tay, and anchoring in the river within the precincts of the harbour of Dundee, but at a little distance from the shore, and unloading their cargoes by means of lighters or boats, which transport the cargo to places at the shore within the said precincts, either on the south or north side of the river, the owners of the ship and cargo are liable in the tonnage and other dues payable under the harbour statutes, or under the ancient crown charters, conferring the right of harbour in favour of the town of Dundee, just in the same manner as if the vessels were moored in the wet-docks at Dundee?

Answer. It appears to us to be clear that vessels coming into the precincts of the harbour, and unloading by means of vessels carrying the cargoes to places within the precincts, are subject to payment of the dues leviable in right of the ancient grants or by Act of Parliament, and that such vessels must be dealt with in reference to the exaction of dues precisely on the same footing as if they had entered the docks.

Query 3. Whether, when a vessel with a cargo (as in this case of the Prince of Wales) comes into the river within the precincts of the harbour of Dundee, and there (within the precincts) proceeds to discharge her cargo, which is carried by lighters to Newburgh, Perth, or other places beyond the precincts, the owners of the ship and cargo are liable in rates on the vessels and goods to the Memorialists?

Answer. We conceive it to be clear that vessels unloading, as the Prince of Wales did, within the precincts of the harbour of Dundee, and transshipping the cargo to places beyond the precincts, are as much liable in dues to the Memorialists as vessels making a similar transshipment in any part of the harbour.

Query 4. Whether the neglect of the Memorialists, or their predecessors, to levy shore-dues on vessels and cargoes, in cases where goods have been landed from vessels either beaching at the shore or riding at anchor in the river *ex averso* of the shore, or discharging at the piers or ferry-stations on the south side of the river, would be held a dereliction of their right, or whether the Memorialists are not now entitled to collect dues in future on vessels and goods at all places, and on both sides of the river Tay, within the precincts of the port and harbour, as described in the crown charter, and in the disposition by the Magistrates and Council in favour of the Memorialists, subject always to the modifications and exemptions specified in the Harbour Acts?

Answer. We think that the Memorialists' right is not derelinquished; and that they are entitled to levy dues within the precincts of the port or harbour, subject to the exception specified in the Harbour Acts, and to the exception which would arise from a grant of port and harbour from the crown, followed by 40 years' exercise of the right of exacting dues under the grant, and further subject to such special exception with reference to vessels loading goods for the exclusive use of the proprietor or tenants, provided such proprietor and his tenants have for 40 years been in use to have goods so landed free from the exaction of harbour-dues. Such proprietors would in no case have any active right of exaction, and no right of immunity, except to the limited extent stated.

Query 5. If it should be thought advisable in the circumstances of this case to institute an action against the owners of the Prince of Wales, and also against the owners of the cargoes discharged or now being discharged from that vessel, within the precincts, before the Court of Session, for payment of the shore-dues both on vessel and cargo, the Memorialists wish to be advised whether the summons ought not to contain conclusions declaratory of the rights of the harbour; namely, to have it found and declared that all vessels loading or unloading on any part of the river Tay, or on the beach or shore on either side of the said river, within the precincts of the harbour, shall be liable in the same dues to the Memorialists, both on the vessels and cargoes, as if such vessels bad been so loaded or unloaded in the harbour or docks at Dundee?

Answer. It appears to us that an action should be instituted against the owners of the Prince of Wales, and of the cargo. We recommend that a letter be written to Mr. Dougall, stating that it had been alleged by the owners that they bad paid dues to him, and inquiring as to the truth of that statement. If his answer be in the affirmative, we think it essential that he should be made a party to the proceedings, and that the action should contain declaratory conclusions; for in no other way could his pretensions be effectually put down.

Query 6. The advice of Counsel is requested generally.

APPENDIX C.

DUNDEE.

No. 145.
Opinion on limits of Trustees' jurisdiction.

Answer. We recommend that proceedings be immediately instituted in the Court of Session against the owners of the Prince of Wales and the cargo; and, in the event of Mr. Dougall supporting their pleas, in connection with his pretended right of harbour, with declaratory conclusions directed against him, affirmative of the right of the Memorialists, and negativing the existence of any claim on his part. We think that, as no pretensions appear to be set up by the proprietors of Newport and Woodhaven, there is no expediency in calling them into the field at present. If any such pretensions are contemplated, the unfavourable issue of Mr. Dougall's pleas will probably lead to their being abandoned.

ADAM ANDERSON.
GEORGE PATTON.

Edinburgh, July 15, 1844.

No. 146.

No. 146.
Washington, on the Tay navigation.

Report on the Tay Navigation by Captain WASHINGTON, R.N., *to the Hydrographer to the Admiralty.*

Her Majesty's Ship Blazer, Queen's Road,
Dundee, October 1, 1844.

SIR,

HEREWITH I have the honour to forward a corrected plan of the river Tay, showing the changes that have taken place in the Gaa sand at the mouth of the river between the date of Captain Slater's survey in 1833, and our examination just completed in September 1844.

Taking advantage of the leisure time afforded while lying with the royal squadron in attendance upon Her Majesty, in the Queen's-road at Dundee, and in accordance with your special instructions on this point, the banks at the mouth of this river have been thoroughly sounded over and examined; the results are all, I am happy to say, favourable, so much so that the shoal hitherto termed "Tay Bar" no longer exists, and vessels drawing 24 feet water may now enter the river, and bring up in safety within its shelter at the lowest water of spring-tides.

On comparing the two surveys,* it appears that the spit of the Gaa sand, within the 2-fathom edge, which formerly extended from its extreme dry point off Buddon Ness, in about a S.S.E. direction, in a compact body (1½ mile in length by half a mile in breadth), has now turned outwards to nearly an E.S.E. direction; has moved bodily half a mile to the eastward; and is broken up into small patches, with deep water between, so that, in spots where in 1833 were only 3 and 7 feet, we have found 16 and 20 feet water. One detached ridge of 12 feet water still remains to the southward of the spit, but from its extreme narrowness, being only half a cable wide, and its crescent-like form, I should imagine the first winter freshes, joined to a spring ebb, will disperse it like the rest.†

While these great changes (in which a mass of sand of not less than six millions of cubic yards has been removed) have been going on on the eastern side, the spit of the Abertay on the western side has grown out a little to the eastward (the natural consequence of being relieved from the pressure of the pent-up tide), but not at all so as to interfere with the entrance, which at the narrowest part is 800 yards wide between the 3-fathom edges. The general depth in mid-channel is also much increased, on an average about 10 feet, so that, as before stated, a vessel drawing 24 feet water, by bringing the Gaa buoy to bear W.N.W., may boldly run into shelter at the lowest spring-tides.

The edge of the Abertay sand is now marked by three red buoys,‡ to be left to "port" on entering, and the Gaa spit by two chequered black and white buoys, to be left to starboard, the passage lying between them, with the two Buddon Ness lights in one, which lead directly past the black Fairway buoy. By day, also, Lord Panmure's monument, recently erected on the summit of Camus Stone Law, kept a little open to the eastward of the remarkable red Gaa sand-hill, will lead up to the entrance.

Within, the channel of the river does not seem to have much altered, if anything it is deeper; a black buoy has been lately placed on the Horseshoe shoal, near Broughty Castle; and the Newcome spit, just off the Craig Lights, still projects from the south shore, nearly half across the river.

Off the town of Dundee we found a rock, named Drummond Rock, not placed in any plan of the river, with only 4 feet on it, marked by a floating beacon; and close in to the westward are rocks called the Gryces, also marked by a floating black spar. The position of the Drummond Rock, just at the entrance of the basin, is so dangerous, that if it be allowed to remain, which I can hardly imagine, it should be marked by a fixed beacon, like the "Fowler" and "Beacon" rocks, in its immediate vicinity. A little to the westward of the town, the "Ballast Bank," lying between Magdalen-yard Point and the Craig rock, has turned out a little, and come lower down the river—a point that requires great attention; the "Middle bank," however, has not increased.

The roadstead in which the Queen's yacht and the royal squadron are anchored lies between these two banks, in 20 feet at low-water springs. It is perfectly sheltered and secure, and the bottom affords good holding ground. As this roadstead has no name on the Admiralty plan of the river, we have ventured to call it Queen's-road, in remembrance of Her Majesty's auspicious visit to this part of Scotland.

The alterations and improvements in the sea-face of the town of Dundee, since the date of Captain Slater's survey in 1833, are great; but compared with its state within the memory of man, "when its harbour was a crooked wall, enclosing but a few fishing or smuggling craft," they almost exceed belief. Two spacious wet-docks, containing an area of 11½ acres, are already completed, and in full activity; another wet-dock, of more than double the extent, is laid out; with two tidal harbours, one

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* The only other plans of the river which I have seen are one by the Messrs. Stevenson, engineers, made in 1816, and that of Greenvile Collins (who by the direction of Charles II. surveyed these coasts in 1680), published in his "Coasting Pilot." The plan purporting to be by Adair, said to have been published in 1690, is a fac-simile of that of Greenvile Collins.

† From soundings taken by Captain Otter, R.N., in Oct., 1845, it appears that the water over the Gaa sand generally had deepened 3 feet in the course of the year.

‡ Three more buoys were added in 1846, a second chequered buoy placed on the edge of the Gaa sand, and the Fairway buoy replaced by one 15 feet high.

APPENDIX C.

DUNDEE.

No. 146.
Washington, on the Tay navigation.

of 5 acres, now in use, the other of 11 acres: besides graving-docks, patent slips, and every requisite for a first-class commercial port. The good result of such enterprise and energy, directed by a skilful engineer, is shown by the more than doubled revenue of the port, and the increase in the number of the shipping that frequent it:—

In June, 1833, the total revenue was	.	. £10,291
In June, 1844 ,,	.	. £23,895

While the number of shipping had increased to 3791, having a burthen of 272,239 tons.

Hitherto all has been prosperous, and probably will be so for years to come; but it is not difficult to foresee that, unless some decisive steps are taken to prevent it, the face of the quays and the entrance to the tidal basins will silt up. Already a dredging-machine is in constant employment. The Fowler, Beacon, and Drummond rocks, just to the eastward of the entrance, in addition to the impediment they offer to navigation, by causing a slack on the flood-tide, are occasioning a deposit, and a slight concavity in the face of the sea-wall tends to lead the silt into the basin; at the same time the Ballast Bank is gradually extending to the eastward, and widening. The most obvious mode of arresting these evils would seem to be by blasting the rocks entirely away, and by running a sea-wall from Magdalen-yard Point, in a slightly curving direction, to the Craig rock, in order to guide the ebb stream in its strength along the face of the quay. This plan, has, I believe, been proposed by Mr. James Leslie, the very able resident engineer; and although there may be some conflicting interests to contend with, everything should give way to the careful preservation of the port, and I trust he may be allowed to carry out his plans.

Continuing higher up the river, as far as Newburgh, the only perceptible changes that have taken place are, I regret to say, caused by embankments and dikes along the north shore. One of these extends into the river upwards of 1000 yards beyond high-water mark; and were a curved line drawn, connecting the outer ends of these dikes, and continued as far as Monorgan Point, which would be the natural shape of the deposit caused by them, it would enclose a space of nearly 2000 acres, or 3 square miles. Now, when it is considered that the whole estuary between Dundee and the mouth of the Earn does not reach 18,000 acres, or 28 square miles (16 of which are dry at low-water), it will be manifest that the space embanked is equal to nearly one-ninth part of the whole estuary; and as the outer ends of some of these dikes have from 10 to 12 feet over them at high tides, it is evident that a large body of tidal water will eventually be excluded, and its scouring power lost, which must have a decided influence upon the banks in the lower part of the river, and opposite the town of Dundee. This is a great evil, and should be jealously watched, as it is the scouring power of the tidal waters ebbing and flowing twice in the 24 hours that is the great agent in preserving our harbours from silting up.

From Newburgh upwards, towards Perth, the changes in the river since the date of Captain Slater's survey have been great and beneficial. Between the years 1835 and 1842 the principal fords, some shoals, and many detached boulder-stones of large size have been removed, and the river along its whole course, between Perth and Newburgh, has been deepened. Three small islands, namely Sleepless, Darry, and Balhepburn, have been connected with the main land by sea-walls, so as to confine the whole of the water in the navigable channel, and render the scour more effective. The banks of the river, where contracted, have been widened so as to admit of the free and equal passage of the water, and a tide harbour has been formed at Perth. In the course of these works not less than 840,000 tons of soil have been dredged up, and the sum of 53,000*l.* has been laid out in improvements, independently of indemnification to the proprietors of the fisheries to the extent of 6000*l.* The advantages arising from these energetic works, carried on under the direction of the well-known skilful engineers, Messrs. Stevenson of Edinburgh, have been many; by affording a free passage to the tidal waters, the flood-tide now begins to flow at Perth three-quarters of an hour earlier, and has a range of 13 feet at the bridge at ordinary springs; a depth of from 4 to 5 feet is said to be maintained in the channels at low-water springs, and the general navigation so improved, that at spring-tides vessels drawing 14 feet water can come up to Perth in one tide with ease and safety.

The natural consequence of this has been, that the number of vessels that resort to this port has much increased; the arrivals and sailings in the past year, amounting to 944, of 45,325 tons burthen, in addition to daily steamers between Dundee, Newburgh, and Perth; the harbour and customs dues have increased in equal proportions, the latter, from about 3000*l.* in 1830, have risen to an average of 16,837*l.* per annum, while in one year they were as high as 25,767*l.*

So far good; but the Tay is susceptible of much further improvement. This magnificent river drains a surface of about 2300 square miles, or nearly double that of any river in Scotland; its length from the source of its most distant tributary is nearly 180 miles, while the variety in the relative distances of its sources furnishes an abundant and equable supply of water without the great floods that the Spey and Dee, and other mountain rivers, are so subject to. These are capabilities that a skilful engineer would readily turn to account; and I sincerely trust the Perth Trustees will go on with the work they have so well begun. Little else is wanting than to remove all obstructions in the bed of the river, and carefully to narrow the channel within certain limits in its upper part, gradually widening as it descends, at the same time dredging and deepening, so as not only to preserve the present but to increase, the sectional area of the channel, thereby affording full and free space for the tidal waters to ascend up to the bridge at Perth, and as much beyond as the natural obstructions in the bed of the river will permit.

The value of such free action to the tidal waters is not confined alone to the upper channel, but is felt in the river throughout. In the former part of this Report I pointed out the great change in the Gaa sand at the mouth of the river, and that six millions of cubic yards of sand had been dispersed since the year 1833, the date of the last survey.

Now, from every inquiry I have made, I do not find that any remarkable freshes in the river have occurred during the last 11 years; but we know that a deepening of the bed of the river in its upper part has been gradually going on since the year 1835, by which a depth of 4 feet has been gained in several places, and the tidal water brought up to Perth three-quarters of an hour earlier. In the course of this dredging we have seen that upwards of 800,000 tons of soil have been removed, and, although it is not easy to make an estimate of the consequent increase of reservoir, it is fair to assume that at least an equal number of tons of water (or say in round numbers a million of cubic yards) have been admitted on every tide.

And when we consider the additional scouring power gained by this increased volume of water

No. 146.
Washington, on the Tay navigation.

passing to and fro twice a-day, or 704 times in a year, it seems a fair inference, in the absence of any other known cause, that this has been the chief instrument in the improvement in question.

If, then, we may assume that the dredging which has already taken place between Perth and Newburgh has proved so beneficial to the Tay Bar at a distance of 25 miles, who can say that skilful engineering along its whole length might not eventually raise this river to the high rank of a Harbour of Refuge, and render the channel into the Frith of Tay as free as the present entrance into the Frith of Forth.

I am, &c.,
JOHN WASHINGTON, *Captain.*

Captain Beaufort, R.N., Hydrographer,
F.R.S., Corr. Inst., France.

P.S.—I have great pleasure in bearing testimony to the ready attention and assistance I have met with from Mr. James Leslie, resident engineer, Lieut. Smart, R.N., harbour-master, and Mr. Kennedy, master of the pilots, throughout our survey and inquiries.

No. 147.
Complaint on the want of a Low-water Pier, and Leslie's report thereon.

No. 147.

Complaint of the want of a Low-water Pier at Dundee, and Mr. LESLIE'S *Report thereon.*

SIR,

Dundee, Dec. 27, 1844.

I AM requested by the owners of the "Modern Athens" to state that, as some alterations are being made by the Harbour Trustees on the composition dues paid by the "Modern Athens," they would feel greatly obliged if the Trustees would take into consideration the high dues paid and the expenses and annoyance caused by the want of a low-water pier.

The amount paid every four weeks, including plank-dues, is 13*l.* 19*s.* 11*d.*, and no deduction is made, although, owing to the weather, a few trips may be lost during that time. The amount paid at Granton pier, for the same period, is only 4*l.*, with the advantages of a splendid low-water pier, cranes, planks, &c. Here you are aware we have to supply ourselves with planks, and have no crane for heavy goods, although we were willing to pay for it. If you look at the dues paid for cattle and stock, all of which would be *travelled* were there no steamer, the Harbour Trust would be benefited although the steamer were to be allowed to sail free of dues altogether: but when I inform you that the "Modern Athens" frequently runs for little more than half the dues and expenses during winter, it will not seem, I hope, unreasonable, that the owners solicit a reduction during a few months.

I may add that, since the new scale of rates were in operation, much loss has been sustained by the dues chargeable on horses, dogs, carriages, cattle, and sheep. It was found necessary either to allow them to go by the road or lower the freight, to meet the increased rate of dues. Strange as it may seem, the carriers took gigs on their carts cheaper than we could, owing to the rates payable at Dundee.

I hope the Trustees will not deem the above impertinent, as my intention is to draw their attention to the consideration of endeavouring to erect some temporary low-water pier, similar to that at Broughty Ferry, and give us such a modification of the dues as may enable us to keep the "Modern Athens" running all winter without a heavy loss.

Trusting you will excuse the liberty I have taken, I remain, &c.,

JAMES KENNEDY.

Report by J. LESLIE, Esq., *on the practicability of constructing a temporary Low-water Pier.*

GENTLEMEN,

Dundee, March 10, 1845.

A REMIT was made to me on 6th January last of the following import:—

"With regard to the low-water jetty to which reference is made by Mr. Kennedy, the Committee recommend that Mr. Leslie be instructed to report to the Board whether it would be practicable to construct a temporary low-water pier for the convenience of passengers."

The site proposed for a jetty in the letter from Mr. Kennedy, the manager of the "Modern Athens" steamer, and here referred to, was, I believe, between the mouth of the harbour and the Craig harbour, or near the slip in the outer wall where the Edinburgh and Perth steamers lie; and he speaks of an erection similar to that at Broughty Ferry; but the Convener of the Committee of Works understands the object of the minute to be a low-water pier at the Beacon or the Fowler Rock.

This, I think, will eventually be the most eligible place, but it would not be suitable or convenient just now for the Edinburgh boats, from the want of proper approaches, and from its being so far removed from the more conveniently situated high-water berth at the western outer wall; and I fear that any projection out from the western wall would be complained of as an obstruction by the Exchequer Loan Commissioners, as proprietors of the ferry, and possibly even by the very parties who are asking for it, as it might be the means of preventing their vessels at high-water from getting conveniently up to the wall unless it were made sufficiently commodious to serve for a berth at all times, both at high water and low water. I would beg to direct your attention to the 5th clause of the Harbour Act of 1836, which gives power to erect a *chain*-pier to the Fowler or the Beacon Rock, and to erect a low-water pier at either of these rocks; and likewise to clauses 54 and 55 of the last Harbour Act (6 & 7 Victoria, c. 83). By the first of these no pier or quay below high-water mark is to be erected without the consent of the Lords of the Admiralty (excepting it may be presumed one for which the sanction of Parliament had already been obtained); and, by the second, the power to erect the low-water pier at the Fowler or the Beacon Rocks is to expire within three years from the passing of the Act (viz. summer, 1846), if it be not completed for the use of the public, with proper approaches, before that time.

After having considered these clauses, I beg to have some more specific instructions from you regarding the site of the proposed pier, and whether it be meant for passengers merely, as expressed in the minute, or for horses, carriages, and cattle also.

The difference in cost between the two would be very material, for this reason, that passengers would only require a stair, whereas for horses, &c., a slip of very considerable length would be neces-

APPENDIX C.

DUNDEE.

No. 147.
Leslie, on constructing a temporary Low-water Pier.

sary; and, in the plan formerly proposed of the low-water pier at the Beacon Rock, the estimated cost of the slip alone amounted to more than double that of the bridge leading out to it.

The only good reason that, it appears to me, can be given for going into this matter just now is not to lose the power of constructing the low-water pier, which has already been obtained, and it is a question whether the erection of any temporary pier, or of anything else than a *chain*-pier, as expressed in the Act of 1836, would effect that object; and, if not, whether it would be expedient to attempt just now the construction of any permanent and expensive low-water pier. I have a sufficiently correct survey of the Beacon Rock to enable me to prepare a plan of a pier there, but the Fowler Rock has never yet been properly surveyed. That is, however, now being done, and, shortly after having received the more specific instructions which I have asked for, I shall be ready to report on the matter.

I have, &c.,
JAMES LESLIE.

EXCERPT from Minutes of the Committee on Works of the Trustees of the Harbour of Dundee, dated 13th, and approved of at an adjourned stated General Meeting of said Trustees, held March 17, 1845.

A report dated the 10th current, by Mr. Leslie, on a temporary low-water pier for passengers was read; and the Committee, having considered the same, recommend that Mr. Leslie be requested to prepare an estimate of the expense of a chain-pier for passengers to the Fowler Rock, and an estimate of a similar pier to the same place for passengers and cattle also. (See No. 149.)

GEORGE MILNE, *Clerk to the Trustees.*

No. 148.

Report by JAMES WALKER, Esq., F.R.S., *on embanking the Shore or Bed of the River Tay.*

No. 148.
Walker, on embanking the bed of the Tay.

SIR,

23, *Great George Street, Westminster, January* 21, 1845.

THE substance of the resolutions of the Trustees of the Harbour of Dundee is—

1stly. That I survey the dikes and other erections and operations of Lord Kinnaird and Colonel Paterson on the bed of the river Tay, detailed in Mr. Leslie's Report to the Harbour Trustees, dated 24th October, 1843, and report my opinion whether or not these erections, as they at present exist, are injurious to the navigation of the river; also whether the effect of the erections and operations of the other proprietors, on the north side of the river, or all or any of them, are injurious; and if so, that I describe the nature and extent of the injury.

2ndly. That I report on the further effect, if any, of these erections and operations, supposing they were completed by embankments so far as the foundations already projected into the river; and

3rdly. That I state my opinion of the views embodied in Mr. Leslie's Report of 24th October, 1843.

In August last I surveyed, generally, the river from its entrance upwards, and particularly the portion from the junction of the Tay and Earn down to near Dundee. I was accompanied by Mr. Leslie. Mr. Blackadder also, the engineer employed by Lord Kinnaird and Colonel Paterson, and whose able report I had previously received by his lordship's orders, met me and accompanied me during part of the survey. Afterwards I attended a Committee of the Trustees, when I stated the expediency of having the portions of the river particularly referred to surveyed and sounded; I also recommended observations to be made on the tides and fresh-water currents, with the sections and velocities at various places, from the entrance of the river to Perth, and upon the Earn. This was agreed to and confided to Mr. Leslie, who, with his assistants, has completed the survey in a very satisfactory manner; so that, independently of this inquiry, the plans and documents cannot fail of being useful to the Trustees as future references. In October Mr. Leslie and his surveyor, Mr. Knox, met me in Perth, when I examined the progress they had made, and directed some further observations and details. On the 12th of December, by which time the surveys and observations were nearly completed, I again visited Dundee, entered with Mr. Leslie into the calculations resulting from the surveys, and had conferences with the Trustees.

On the 14th of December Mr. Leslie accompanied me to Perth, where Mr. Blackadder met us, and the various matters were discussed.

I have, in the course of the reference to me, had communications with Lord Kinnaird; and, having informed the principal landowners when the plan was finished, that they might have the opportunity of seeing it and offering any remarks, I have been waited upon at Dundee by Captain Allen, jun., of Errol, and Mr. Walker, Lord Kinnaird's agent.

On my visits to Dundee I have received detailed information as to the depths and tides below Dundee from Baillie Martin, also from the Harbour-Masters and Trinity Master.

I think it right to state the above in order to show that my opinions, which I am now to report, though they may be erroneous, have not been formed without ascertaining the facts that appeared to me to bear upon the question, or without hearing what those who are most interested or qualified had to say respecting it.

The duty of preserving entire the navigation of the river Tay has become much more important of late years by the increase of trade that has taken place since docks were formed at Dundee, rendering the port, even in its present state, of almost national importance.

The character of the 10 miles of river below Dundee is very different from all that is above it; and this was probably the motive that led to the town of Dundee being fixed where it is. The course, from the entrance of the river to opposite the docks, is nearly one straight line; the width ample and clear of shoals, excepting at one point (the Horseshoe Sand), and even there the deep water is one-third of a mile wide. The two extreme points, however (viz. the approach to the docks at the upper end, and the entrance to the river at the lower end), require the vigilant care of the Trustees.

For the whole length opposite the docks there is very little more depth than upon the sill of the entrance, so that any diminution there would be attended with very injurious consequences. The

APPENDIX C.

DUNDEE.

No. 148.
Walker, on embanking the bed of the Tay.

Trustees were obliged, in 1843, to dredge in front of the upper entrance to the harbour, in order to procure the requisite depth for ships entering; and a comparison of maps shows that the "Ballast Bank" to the westward of the town is extending downwards. Again at the entrance of the river (the bar) there has been a constant struggle between the ebbing water from the river forcing the sand out of its way and the waves of the sea trying to drive the sand back. Hence the spits, and the bar, and the shifting channel, which require a constant attention on the part of the harbour-master to place the buoys of the entrance in the best situations for the deep water. It appears from information, and from the old charts,* that 150 years since, and up to 70 years since, the best water out to sea was a continuation of the river-course S.E. by E. half E. (the Craig or inner lights "in one"); that then the extension of the Gaa sand, on the north side, blocked up the straight passage to 5 or 6 feet at low-water; that, as a consequence, the effluent water deepened a passage in the S.S.E. half E. direction (the present buoyed passage); that matters remained thus until 15 or 20 years since, when the depth upon the tail of the Gaa sand again increased. The Admiralty Chart of 1833 (Captain Slater's) shows only 8 and 9 feet upon the Gaa sand. There is now 14 to 16 feet, excepting upon small patches. At the same time the Abertay, or south sand, appears to have been advancing again to the northward, and the recent shifting of the buoys has been in that direction. The Admiralty Chart of 1833 gives 16 feet upon the bar at spring-tides. Mr. Jack, the deputy harbour-master, states it now to be 18; but the general result of the various information I received, and my conviction from that information, is, that the depth of the entrance has not varied during the last century and a half. Adair's Chart (supposed 1690) gives the depth upon the bar 3 fathoms in the straight line, the Gaa sand then stretching out nearly east by compass.

These facts are named to show that there is nothing to spare, and that the cause, whatever it is, of the present depth should be watched with the most jealous care.

At Dundee the high-water width is one mile and a half. It contracts gradually to Broughty Ferry, three miles down, where the channel is through rock and the width is only three-quarters of a mile; but three miles above Dundee we find it nearly three miles wide, and at ten miles higher up it is still one mile wide—the average width being about two miles. Mr. Leslie calculates the area between Dundee and the mouth of the Earn at 17,800 acres, or 27¾ square miles. Where this widening, which is immediately above Dundee, begins, the shoals begin; there is no longer the straight, clear, deep low-water course. On the contrary, four-sevenths of the area are dry at low-water, and the three-sevenths that remain covered with water are shallow when compared with the river below Dundee.

In this description a great similarity between the formation of the Tay and of the Mersey, from the sea to Runcorn, will be observed.

It is upon the north side of the wide and therefore shallow part of the river, which is known as the "Estuary," that the erections and operations referred to for embanking and reclaiming the soil of the river, between high and low water, have been carried on. They commence at the boundary of Colonel Paterson's estate (Castle Huntly), four miles above Dundee; and extend upwards in front of the estates of Lord Kinnaird, Mr. Hunter of Seaside, Mr. Allen of Errol, and Sir John Richardson of Pitfour, at the confluence of the Tay and the Earn, which is 15 miles above Dundee.

When the margin of the land was unprotected and exposed to the wash of the waves during high winds, the water may be supposed to have been generally gaining upon the land and enlarging the expanse of the water. Mr. Blackadder arrives at the same fact by the geological similarity of the strata. The level of the land close to the river being in most places upwards of 20 feet above high-water, the quantity of alluvial matter that has been washed into the river and then out to sea, in the course of ages, may have been great.

I am not at all disposed to dispute Mr. Blackadder's geological theory of this, but it is clear that the water has now the possession, and has had it too long to be legally ejected, for the oldest charts show the width and margin of the estuary much as they now are.

As the ground increased in value it became desirable to stop any encroachment of the water; and this was done by the erection of dwarf walls at the foot of the bank to protect the loose soil.

The object and progress of the cross dikes, which are sloping walls of rough stone, projecting out at right angles from the shore, are stated by Mr. Leslie to have been, that they were begun by a former owner of Errol, as a substitute for the dwarf walls already named, which had been put up to prevent the waves from undermining and washing down the land into the river; and that the deposit between these dikes of the matter which is brought down the river by the freshes, being the result of the same operation, the outer ends of the cross walls were connected by longitudinal walls so as to entirely exclude the water, and convert into arable land the area which before was generally covered with water when the tide was up.

These enclosures have not prescription to plead in their favour. None of them are, as I was informed, more than ten years old; and the entire exclusion of the water even now is confined to portions in front of the Pitfour and Errol estates—the whole quantity being from 100 to 200 acres. The fine quality of the ground that has thus been embanked has led Sir John Richardson and Mr. Allen to adopt measures for taking in land outside their first enclosures; and the other proprietors are following their example, by the erection of dykes and bush-fences (stakes driven into the ground and interlaced with wicker-work) in various directions in front of their estates. These, by interrupting the current, and, which is much more effectual, by interrupting and breaking the force of the waves upon the shore, and quieting the body of water that is within the dikes, form, virtually, traps or nets to catch and deposit the alluvial matter which is brought down the river, and is held in suspension while the water is in an agitated state.

The longest of these dikes, until May, 1843, was 600 yards. At this time a new dike was begun upon the boundary between Lord Kinnaird's and Colonel Paterson's estates. This one is already 1037 yards, or four-sevenths of a mile long, nearly one-fourth the whole width of the "estuary," where it is the widest; and it is uncertain how much farther it is intended to be carried. Mr. Leslie has calculated that Lord Kinnaird's cross-dikes may enclose 340 acres in front of his Lordship's estates. None of the other walls are of more than half the length of Lord Kinnaird's. But if walls were built to connect the ends of all of them, a surface of upwards of 1800† acres, or one-tenth of the area of the estuary

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* The oldest chart is by Adair, a copy of which Mr. Blackadder has kindly furnished me with.

† Mr. Leslie states 1930 acres, which includes the spaces on the north side of Mugdrum, and the enclosed land in front of Errol.

APPENDIX C.

DUNDEE.

No. 148.
Walker, on embanking the bed of the Tay.

between Dundee and the Earn, which is now open to the tide, would be embanked. Of this a portion, near the shore, and between the dikes, and on the north side of Mugdrum, is already covered with reeds and salt grass, so that spring-tides only rise over it. The average present depth of spring-tide over the whole space, and which would of course be excluded if the ground were embanked, is 8 feet. I say *present* depth, because the tendency of the dikes has already been to reduce the depth under what it was at the time of their erection.

A very leading question in the consideration of this matter is, whether, and to what extent, the depth and width of the river between Dundee and the sea is the effect of the occasional land-floods (the fresh water), or of the sea-water in its passage *into* the estuary with every flowing tide, and *out of* the estuary with every ebbing tide. To supply materials for correctly ascertaining this fact was one of the principal objects of the surveys and observations that have lately been made, and the distinction should be borne in mind. In the Clyde, at Glasgow, the tidal current is not half a mile per hour; when the land-freshes come down, the velocity is four miles per hour: therefore the value of the tide at Glasgow, as a scouring power, is comparatively of little account. At Greenock the reverse is the case; there the land-floods become unimportant as compared with the tide. It was therefore one of my objects, while designing the improvements of the Clyde, to keep down the dikes in the lower portion of the river, so as to prevent, as much as possible, a diminution of the tidal water at Port Glasgow or Greenock. So also in the cases of Liverpool, Yarmouth, Montrose, and many of our great harbours, which depend for their existence upon the tidal current, and where, therefore, the receptacle for tidal water ought to be preserved with jealous care. Now, what Glasgow is upon the Clyde, Perth is upon the Tay—dependent, so far as natural means are concerned, upon the river floods for its harbour; and as the discharge of the Tay is more than twice that of the Clyde, this natural power is greater at Perth than at Glasgow. In both cases the tide flows only two or three miles above the cities; and the rise or "lift" of a spring-tide in the two harbours is nearly the same.

Let us now see the situation of Dundee, and endeavour to ascertain the relative value of the river and of the tide to that harbour.

I requested Mr. Leslie to take the opportunity of measuring the united discharge of the Tay and the Earn during a flood. The highest since then was on the 12th November, 1844. He states it to have been a full average flood, but that an extreme flood, after heavy rains, and a sudden melting of snow, would be four feet higher, when the discharge would therefore be considerably greater; but, as these cases are not frequent, the November flood is considered sufficient for general calculation.

The discharge of the Tay was 753,740 cubic feet per minute.
,, of the Earn 215,600 ,, ,,

Together 969,340;

say, in round numbers, 1,000,000 cubic feet per minute; or 240,000,000 during four hours.

To compare the above with the effect of the tidal water at Dundee, I assume 15,000 acres as the average area (above Dundee) of the reservoir or estuary, during the first four hours of the ebbing tide, and the vertical fall of tide during these four hours to be 11 feet. This will give 7,187,400,000 cubic feet, or thirty times the 240,000,000 of river water.

To compare the effect upon the bar, the area of the river between Dundee and the bar must be added; and the tidal water upon the bar will then be upwards of forty times the river water.

The small sectional area, or width and depth, of the river above the estuary during a flood, compared with that below Dundee, is another proof of the great superiority of the tidal current. At Broughty Ferry (the most contracted point, owing to the rocky margin) the width and depth are each three times those of the river above the estuary; the sectional area is, therefore, nine times that of the river, and the velocity at Broughty is greater than in the river.

It is evident therefore that the effects of the river at Dundee are but feeble in comparison with those of the tide. It is only when they are reduced to figures in this way that the vast disparity is seen; and the above calculations confirm what is stated by the pilots and others, that the difference between a spring and a neap tide is much greater than the difference between a tide with, and one without, a land-flood; and that the current near the harbour's mouth is not perceptibly affected by a fresh, except at low-water. I do not mean to say that the water of the Tay is of no use to the harbour of Dundee. On the contrary, besides adding to the quantity at all times, it forms a low-water channel through the estuary when the tide is out, and keeps clear that portion of it which the tidal water alone would not.

The idea of a gradual contraction of the river from Broughty Ferry upwards has been suggested as a desirable improvement. This would reclaim many thousand acres of fine land; it would also cause a quicker current through the contracted portion of what is now the estuary, and would improve the navigation of the river upwards (all in themselves useful and desirable objects); but it would ruin Dundee by depriving it of two-thirds of its present tidal reservoir. That the reservoir should be of a regular shape, with fair tapering sides, is not a matter of consequence, so far as Dundee is concerned. Quantity, at the proper time, is the consideration. The first cause of the current between Dundee and the bar is the sinking of the tide at sea, not the pressure from above. Indeed, the more slowly the water approaches to the point above Dundee where its action is required, the better. The small velocity shows that but little of the head, or power, has been expended in arriving there. Therefore, even if the reduction in quantity caused by narrowing the estuary were to be restored by extending the length, this (as the average distance of the water would be increased) would not be so good as the present shape, which is nearer the circle, the best of all figures for the purpose, if gradually contracted at the outlet, in a balloon-like shape, to form an easy transition into the parallel or river shape before reaching Dundee, or where velocity is required.

It is true that the sluggish current of the fluid in such a figure would tend to allow a deposit on the estuary; but it is a mistake to suppose that the depth of the estuary, except in and near the low-water channel, is the effect of the current. I consider it to be almost entirely the effect of the wash of the waves during high winds; and as a contraction in width is a certain way of reducing the waves and encouraging silting, I think it injurious. Were a gradual contraction to be made from Broughty Ferry upwards, the waves would cease to have effect in the space above Dundee: the current would become the only power. The width, thus reduced by art, would be still farther reduced by the natural formation of a fore-shore in the front of the dike or bank, and this fore-shore

APPENDIX C.

DUNDEE.

No. 148.
Walker, on embanking the bed of the Tay.

would gradually rise above the level of the reclaimed land within the bank. Experience has proved this to be the progress in all similar cases.*

My opinion on the point submitted to me by the Commissioners must be in accordance with these principles, and that the reduction of the estuary by the proposed enclosures would be injurious to the harbour. Is this to such an extent as to be a practical evil? because, as has been said, and said truly, a single pile, if between high and low water, takes the place that would be occupied by water were the pile not there, and is, on principle or theory, an injury, although a thousand piles might not practically be so; and if they were not, there would be no useful object in preventing their being driven. That this is the feeling of the trustees is indeed implied by their requesting me to report on the nature and extent of the injury I may anticipate.

As the extent of the exclusion of tidal water, by connecting the outer ends of the present dikes, so as to embank the space that would then be enclosed within them, is defined, and gives a basis for calculation, I shall take the liberty of considering this question first.

I have before taken the area which would thus be enclosed at 1800 acres, or one-tenth of the whole estuary; but as the rise or lift of an average spring-tide is 16 feet at the lower, and 13 feet at the upper end of the estuary, or, on the average, 15 feet (having reference to the shape), while the present average depth over the space that would be enclosed is only about 8 feet, the abstraction of water is not in proportion to the area, nor much above half this, or say one-twentieth of the whole cubic quantity, and therefore the question appears to resolve itself into this: Would taking away one-twentieth of the whole quantity of water that passes through the channel of the river at Dundee, or one-thirtieth of the whole quantity that passes through the mouth of the river inside the bar, be a practical injury? I have no hesitation in answering both these questions in the affirmative.

Having before compared the whole of the tidal water passed out of the estuary with the water of a land-flood, a comparison between the latter (the land water) and the water that would be excluded by the embankments will give an idea of their relative value. The whole quantity of the united Tay and Earn that is poured into the estuary, and goes out with the tide, during four hours of a land-flood, has been given as 240,000,000 cubic feet. Now, 8 feet in depth, over 1800 acres, gives 627,000,000; in other words, the 1800 acres, supposed to be embanked, now add to the ebbing tide, at every spring tide, considerably more than two and a half times the quantity supplied by the rivers during four hours of a land-flood; or, in other words, if the river-water were to be turned into an enclosed space of 1800 acres, it would require ten hours to raise it to 8 feet in depth. Unless there is some fallacy in these figures, it seems difficult to come to any other conclusion than that connecting the ends of the dikes would be injurious to the harbour.

In the instructions to me, the operations of Lord Kinnaird and Colonel Paterson are distinguished. The quantity, by connecting their dikes in the shape described by Mr. Leslie, would be 340 acres, or nearly one-fifth of the whole. The cubic contents, at 8 feet deep, is 118,000,000; so that this surface alone supplies more to the ebbing current than two hours of a river-flood would do.

It is impossible, then, to give the opinion I have done as to the whole, and to give a different opinion on the abstraction of so large a proportion. And it is to be remembered, that the spring-tides occur about four times in every two weeks, and are therefore much more frequent than the river-floods. I think that the November flood is the only one that has occurred for many months.

The above calculations are taken on an average depth of 8 feet. It is almost unnecessary to say that the portion near the foot of the bank, which is covered with sea-grass and reeds, and is now but little under the high-water level of spring tides, contributes but little to the quantity; so that the injury done by enclosing this alone would be but small in proportion—indeed would not come within what I have described as being practically injurious. I had no correct means of ascertaining if these reed shores existed anywhere before the dikes were begun, or if they were the effect of them. If the former, it would appear that, in such places, the land had been naturally rather gaining upon the water. This is a matter for evidence. There can be no doubt, however, that the erection of the dikes has increased, if not formed, the growth of reeds, for which only a particular level below high-water is suitable.

In the calculations I have made, and the opinions I have founded upon them, I have included only the space that would be enclosed. The silting effect of the embankments upon a portion of the large space also that would be left between the outside dikes and the low-water channel, would, though gradual, be certain, and in the end considerable. I have already referred to it as arising from the contraction of the width and consequent quieting of the surface, or "laying" of the waves, to which, and not to the current, the depth is due; and I am desirous of having this understood, as the contraction of the estuary has been prescribed for deepening it, which it cannot, in my opinion, do, unless the width be so reduced as to be kept clear by the river-water quite up to the banks; that is, unless the estuary be entirely done away with. In advising as to embanking in other places, I have acted upon this principle, not recommending the whole intended finally to be reclaimed to be enclosed at once, but only a partial measure to encourage a silting in front of it, and to make the embanking of the outer portion more easily accomplished afterwards. I have no reason for suspecting that the landowners have this in view—that they see in the 1920, or the 1800 acres, only a first instalment; but the fact will be that the unenclosed ground, particularly towards the upper end (Sir John Richardson's and Mr. Allen's), will, after a series of years, be more easily embanked; and from the gradual accretion upon its surface, the abstraction or enclosure of a further space will then become of less consequence to the interests of navigation, just as the present reed shores have become, or at least now are.

My desire to avoid, in this report, all that is not really practical, must not extend to prevent my saying, that the injury done by any diminution of the power which scours the river and removes obstructions, is not simply in proportion to the quantity abstracted. It is in a greater porportion; that is, if you take away any, say half the quantity of the water that now keeps the river open, although, by doing so, you reduce the velocity only one-half, you take away much more than half the power. Every one used to canal or river navigation knows that very much less than one-half, even less than one-fourth, the power is required to draw a boat through still water, at one mile per hour, than

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* It is fair to Mr. Blackadder to say, that the opinion he has given, as to the embanking not being injurious, has reference to the enclosures that would be effected by the present dikes, and not to any such extensive contraction as I have here referred to.

APPENDIX C.

DUNDEE.

No. 148.
Walker, on embanking the bed the of Tay.

at double the speed,* and also, which is indeed the same thing, that very much less than half the power is required to hold a body at rest against a stream which runs at the rate of one mile, than against a stream of two miles per hour. And the same principle extends in a degree to the power of rivers to widen and deepen their channel.

Mr. Blackadder states in his report, that, according to Mr. Jardine's survey of the Tay in 1810, "the estuary does not fill up level with water, and that the medium depression between Broughty and Newburgh is 15 inches below that of the tidal waters at its confluence:" and he gives the opinion of a gentleman, high in physical and mathematical science, to whom a similar case had been submitted; which was, that "there could be no sensible exclusion of tidal water when the internal estuary did not fill up level with the external tideway at high water."

This was an opinion on a particular case, and there is always danger in generalizing from particular cases. As Mr. Blackadder says the Tay is similar, I have his respectable authority for its being so. May it not, first, be fairly inferred from this, that Mr. Blackadder and the gentleman he consulted thought that the tendency of any operation which excluded water was injurious; and that the reason why injury, in the case Mr. Blackadder referred to him, was not done, was because there was no exclusion of water? Now, in the case of the Tay, it must be evident without another array of figures, that, if the estuary were contracted until this depression were filled up, a very much greater quantity of the contents of the estuary or reservoir must be taken off than would fill the depression. Or, to take the abstraction of 1800 acres (the subject-matter of our inquiry), would this abstraction lessen the present depression one inch in the deepest part, or half an inch over the surface depressed? Probably not; but even if it did, this would not be one-twentieth of the quantity that would be excluded by the embankment. Indeed, if Mr. Leslie's section be taken as a basis, the proposed enclosure of 1800 acres would alone exclude twice the quantity of the whole depression.

On referring to Mr. Jardine's section, I see that the greatest depression is opposite Flisk church, where the water is 8 inches lower than at Broughty; that the Broughty level is attained again opposite Inchyra; and that the average depression from the sea is about 12 inches.

Mr. Leslie's recent survey makes the greatest point of depression to be at Dundee, where it is 8½ inches lower than at sea. So soon as it enters the estuary the inclination is upwards, tending to restore the depression. Nine miles above Dundee the Broughty level is regained. At Inchyra the sea level is regained; and at Perth the tide is 10 inches higher than at sea. I have confidence in Mr. Jardine's and Mr. Leslie's accuracy; and conclude that the variation in the two sections is from their having been taken at different states of the river, or more probably of the wind.

A very large diminution of the estuary must take place before the sea level could be carried through—it must be something like a regular contraction from Broughty Ferry upwards; and what I have said on that subject is, I hope, sufficient to show how injurious the effect of this would be. At the same time I quite agree, that if the sea level could be carried throughout, or exceeded, as is the case in some rivers, this would be desirable, if it could be done without a concomitant evil. The real would not, however, be so great as the apparent benefit, because the loss of water by the depression is at the top of the tide. The first half-hour's ebb restores the level; and this is long before the current has acquired such a velocity as to be useful for a scour. Again, whether Mr. Jardine's or Mr. Leslie's levels be taken as correct, it appears that nearly all the depression takes place between the sea and Dundee; in other words, that the throat or gorge of the estuary is not large enough; and Mr. Blackadder will, I think, agree with me, that it would be better for Dundee to endeavour to get rid of the depression by enlarging the throat, than by diminishing the estuary. The narrowest point is at Broughty, where an enlargement would be useful. The sides, being rock, are not moved by the velocity, great as it is. If, from buildings or otherwise, an artificial widening cannot be obtained, the greatest care ought to be taken that the waterway at Broughty be not encroached on. I name this, because some operations appeared to be carrying on there; and whatever is done should be carefully attended to. A diseased throat is perhaps as dangerous as a disordered stomach.

Having thus stated, at perhaps greater length than may be thought requisite, my reasons for thinking that enclosing the whole spaces between the ends of the dikes, whether those of the different landowners, or of Lord Kinnaird and Colonel Paterson only, would be injurious, it follows that the dikes and other operations of Lord Kinnaird and Colonel Paterson, as well as of the other landowners, which have, in their present state, the effect of causing a deposit of soil, thereby raising the surface and lessening the estuary, are injurious also. To what extent this has already taken place I have no means of judging. The levels now taken by Mr. Leslie, under my direction, being the first, there is nothing to compare with. The deposit in the Dundee basins was stated to be at the rate of 16 inches per annum. In these the depth of water is greater than upon the shore of the estuary, and there is no wash or wave in the basins to disturb the mud after it has deposited in them, as there is upon the shore of the estuary, until the reeds grow. Perhaps 4 inches to 6 inches per annum over the whole surface may not be far from the truth. Having stated the cubic quantity of water which would be excluded by the entire embanking out of the tide, the effect of any gradual deposit will be in proportion to the depth, so that the calculation is simple; but I am unwilling to prejudice the question by stating quantities from uncertain data. Undoubtedly the silting operation is in progress; indeed, the dikes and other works have been made for the purpose of silting, and as a preparation for the entire exclusion of the water. This the landowners will not deny; nor, as gentlemen, will they be disposed to defend the process or gradual steps towards an object, if the object, when perfected, be proved to be injurious. I am not aware when they were first made acquainted with the objections to the embanking on the part of the Trustees of Dundee harbour. If this was before these expensive works were done, the wrong has been theirs, and there will be less sympathy with them. If no notice was taken of their proceedings, this is to be regretted. I quite agree with Mr. Leslie, that the interests of Perth and of Dundee are not "as one" in the matter; and I apprehend there is no doubt of this, that, even if the Perth authorities are the conservators of the whole river, their approving or not objecting would not legalize what could be shown to be injurious to the navigation up to Dundee. It is to be hoped that the improvement and extension of Perth harbour can be effected without prejudice to the lower navigation. Messrs. Stevenson, the Engineers to the Perth Commissioners, do not, in any of their reports I have seen, refer to a contraction of the estuary as part of their plan. On the other

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* The increase of power during the time it is exerted is as the cube: that is, if the velocity be doubled, eight times the power must be applied, and, of course, double the distance will be gone over in the same time.

No. 148.
Walker, on embanking the bed of the Tay.

hand, the Trustees of Dundee harbour can have no wish to prevent an improvement of the estates adjoining the river, if it does not involve an injury to the navigation.

The opinion that a regular fair line between the river and the land would create a current, and be a better preventive to the deposit than the present very irregular line, has been stated by one of the gentlemen most largely interested.* Agreeing with him, as I do, that there is at present no current upon the sides of the estuary, at either flowing or ebbing tide, to prevent deposit, I feel equally certain that the connecting the ends of the dikes will not practically alter the case: and I think I have said enough to explain why I feel so, viz. that the disturbing cause is not the tidal or river current, but the wash of the wave; and I really believe that much of the difference of opinion arises from what I consider a mistaken view on this point. The difference between the clear state of the water on a calm day, as it approaches or leaves the shore, and the muddy state on a day when there is any wave, or even the surface ripple or "jabble," is proof of this.

In his report Mr. Blackadder refers to contractions or enclosures upon the Clyde, and upon the Ouse at Lynn, as having been accomplished without injury to the harbours.

I have already stated that, upon the Clyde, provision was made by me, not to exclude the tidal water, while the navigable channel was to be straightened and deepened by artificial means; which would be the least objectionable, indeed, so far as I can see, an unobjectionable way of improving the navigation in the upper part of the Tay.

The harbour of Lynn was surveyed by me, and reported on in great detail in 1825. After the completion of the Eau Brink Cut, to which Mr. Blackadder refers, the harbour was improved in some respects, in others the reverse. On the whole, the balance was favourable. The new works consisted in substituting a straight and deep for a narrow and tortuous channel, in a shallow estuary, which caused cross currents in the harbour; and in deepening and enlarging the river Ouse for many miles up the country, by which the quantity of effective tidal water was increased.

A reference to Mr. Telford's published account, or to the living evidence of Mr. Gibb, will prove that this was also the case with the Dee, at Aberdeen; and I believe that the Forth, the only other river named by Mr. Blackadder, would not, were the particulars known by me, be found in opposition to the general principle,—the laws of nature being general. Mr. Blackadder, however, knows another Dee (the Chester river), and other harbours, where embanking has been injurious; and I think I might be able to convince him that the principle of tidal or backwater, upon which I have based my opinion, is applicable to Dundee; and that the supposed exceptions are to be accounted for by applying that principle to harbours which depend on other causes; as, for example, to the harbour of Perth, for which a contraction from Dundee up to Perth would be beneficial, although, from being attended by a great diminution of tidal water, it would be injurious to Dundee.

The third query, as to my opinion of the views embodied in Mr. Leslie's report of 24th October 1843, will be more distinctly ascertained by a reference to his and my report. It will, I think, be found that, in principle, our opinions do not differ. I have avoided repeating those details which are very fully and clearly stated by Mr. Leslie; and in taking generally the quantities, which form the groundwork of my opinion, somewhat lower than he has done, my object has been, not to dispute his correctness, but to take the low side where the data are uncertain.

Neither of us would, I am sure, object on principle to a judicious mode of marginal embankment, cutting off all the sinuosities which Mr. Blackadder recommends, if it be done without an injurious reduction of the tidal water; but I am convinced that no embanking could be formed to such an extent as to effect a scour upon the sides of the estuary, without serious damage to Dundee.

I am, &c.,
JAMES WALKER.

No. 149.

No. 149.
Leslie, on proposed Low-water Pier.

Report of J. LESLIE, Esq., C.E., *on a proposed Low-water Pier at Dundee, and Estimate.*

GENTLEMEN,

Dundee, May 14, 1845.

AFTER having given the fullest consideration to the question of a low-water pier, and having taken the necessary soundings and other measurements, I have prepared five designs, which I beg herewith to submit to you.

No. 1 is a stone pier on the outer side of the Beacon Rock, of 500 feet in length, and sixty feet in breath, set parallel with the shore, so as to interrupt as little as possible the flow of the tide, and having a slip of twenty-five feet in width on each side, down to within five feet of low water, and a parapet wall in the centre.

This low-water pier is proposed to be connected with the shore by a suspension bridge, having three spans of 240 feet each, with one of the pillars set on the Beacon Rock, one on the Fowler Rock, and one in the water between the Fowler Rock and the shore. I would propose to excavate down to low water the whole surface both of the Beacon Rock and of the Fowler Rock, which is not covered by the low-water pier or the pillars of the bridge; and if this were done, the current of the tide would be much less interrupted when the pier is built than it is at present.

The depth at low water of spring tides, close to the outer end of the slip, is twelve feet, but it deepens rapidly outwards.

The estimated expense of this plan is 21,750*l.*, whereof 14,300*l.* is for the pier, and 7,450*l.* for the suspension bridge.

I have not thought it advisable to propose any less complete kind of work at the Beacon Rock, such as having only a foot bridge out to it, or to endeavour to lessen the expense by stopping short at the Fowler Rock; for the greater part of the expense, it will be observed, lies in the pier, and not in the bridge; and although the cost of the former might be materially lessened by making it a small building, with stairs down to low water, instead of a double slip, I do not think that it would be prudent to do so; for vessels could not go with safety to a pier in this rather exposed situation, unless the whole length of the rock were covered so as to keep them from being driven upon it, and to afford them shelter inside when blowing strong from the south-west. The danger would be increased by making the landing place at the Fowler Rock, as there would be little room to turn at that place, and there are snags of rock to the south-west of the Fowler Rock, which would make the passage through to the west unsafe.

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* Captain Allen, R.N., younger, of Errol.

APPENDIX C.

DUNDEE.

No. 149.
Leslie, on a Low-water Pier.

There are difficulties in the way of framing a low-water pier anywhere at the western outer wall, and any where at the eastern outer wall, excepting near its eastern extremity, owing to the shallowness, and to the bottom being rock, which prevents its being deepened by dredging.

I therefore propose to form the low-water pier near the eastern extremity of the eastern outer wall, and immediately south of the new entrance lock, where there will be a direct access by means of a swivel bridge to the eastern part of the town, and to the Arbroath Railway, the terminus of which must sooner or later be moved farther east.

The plan, No. 2, is a wooden slip, seventy feet out from, and parallel with, the outer wall. The slip is twenty feet with an inclination of one in ten, and is 160 feet in length, so as to reach down to within five feet of low water. There is a platform over the slip, on the level of the wall, as far up as it can be carried consistently with allowing head-room below; and by means of a crane placed on this platform the operation of loading and unloading goods may be much expedited. An open space is left between the pier and the wall, which may be covered over at a future time to make room for sheds or for other purposes.

The expense of constructing this plan, of Memel timber and of scupper-nailing the lower ends of the piles, so as to protect them from the marine worm, would be 3200*l*.

No. 3 is a similar pier, excepting that it is shortened, and has stairs instead of a slip, and is consequently not fitted for embarking or landing cattle, carriages, and heavy goods at low water. The expense of the plan is estimated at 1620*l*.

In both these designs there is room for a vessel to lie at either end of the pier, where there might be some shelter when the wind is up or down the river, but it is impossible for a vessel to get within thirty feet of the outer wall at low water, as that wall is founded upon a mound of stones, which extends from twenty-five to thirty feet out, and is as high as the level of low water.

This mode of founding was adopted to save the heavy expense of sinking the foundation down to the depth necessary to reach the hard, viz., eleven feet below low water of spring tides.

After these two last designs had been prepared and estimated, I considered the expense too great for me to recommend either; and, therefore, I have prepared two others, Nos. 4 and 5, similar in other respects, excepting that the timber work does not project beyond thirty-five feet from the outer wall. No part of either of them is separated from the wall by an open space covered with water, and consequently a more complete and commodious access is afforded. The depth is only a few inches less, as the ground is nearly level; and the only disadvantage, as compared with the two former plans, is the want of berths at the ends. On the other hand, from the projection being less, the obstruction is also less to vessels passing along the outer wall from the one harbour to the other; but in all the four plans the ends are not carried out square from the wall, but are levelled so as to be less apt to catch vessels passing up or down.

The depth at this place is only about 3½ feet at low water of spring tides, but the bottom is soft mud, and it would be very easy to dredge out a berth at the pier, with a channel for access to it, with a depth of six feet at low water of spring tides, which would accommodate any vessel of similar size to the Leith steamers.

No. 4, it will be observed, has a slip like No. 2, with the addition of stairs to give an additional low-water berth for passengers. The expense of this plan is estimated at 2300*l*.

No. 5 has merely stairs like No. 3, and the estimate is 1230*l*.

From these works being formed of open framing, they would present no obstruction to the tide, however far they may be carried out.

I believe, however, that a substantial stone slip might be constructed outside of the wall, without projecting so far as to injure the currents; but it would be a tedious and rather expensive operation to found it deep enough. The mud bottom is unfavourable for doing the work by the diving-bell, and the ordinary mode of doing such work, in coffer-dams, requires a quantity of stuff to be thrown down alongside to exclude the water, which would have to be all dredged out again, before the slip could be available as a low-water pier.

I would rather, therefore, recommend, in the first place, the construction of a timber pier, which might last twenty years or more; and if it were found to answer the purpose, and that it could be kept deep without a great expense for dredging, a stone or an iron pier may be constructed to replace it when it is done, or in the event of more extensive accommodation being required.

On the whole, I would recommend the adoption of the design No. 4, costing 2300*l*., as it would answer the most of the purposes that would be served by the low-water pier at the Beacon Rock, at one-tenth part of the cost, while its distance would be a quarter of a mile less from the east end of the town, and fully 100 yards less from any other part of the town than the Beacon Rock pier. The proposed site is fully half a mile more distant than the present slip on the west outer wall, from any part of the town west of Union-street, but it is exactly the same distance from the foot of Trades-lane, and those parts of the town whence the greater part of the manufactured goods come for shipment; and the manager of the *Modern Athens* steamer says that the eastern site would be quite as convenient for his trade as that of the present slip

At the same time, while I give the preference, under present circumstances, to the pier on the outer wall, I should wish it to be distinctly understood, that I do not mean thereby to disparage the Beacon Rock plan; which, in respect of its greater depth of water, has a decided advantage over any other site that can be procured in connexion with the harbour.

There are, however, certain disadvantages attending such a great projection into the river, such as the shutting up of the passage between the Fowler Rock and the outer wall, which would be to some extent an inconvenience, particularly as regards vessels going from the one harbour to the other; and, although this inconvenience would in my opinion be much more than compensated by a low-water pier, accessible at all times to vessels drawing twelve or fourteen feet of water, and having every accommodation for the shipping and landing of passengers, carriages, cattle, and heavy goods, I should doubt whether the inconvenience ought to be submitted to merely on consideration of getting a foot bridge, and a low-water pier, with stairs fitted for the landing and embarking of passengers only, and not for carriages and cattle.

Therefore, until funds can be provided for the construction of a really good and complete pier at the Beacon Rock, I would not recommend to attempt any work there, although the consequences of delaying it more than a year from this time be the losing of the powers to build a low-water pier at the Beacon or the Fowler Rocks, conferred by the Harbour Act of 1836.

I have, &c.,
JAMES LESLIE.

No. 150.
Jardine, on embankments at Broughty Ferry.

No. 150.

Report by J. JARDINE, Esq., C.E., *in the case of the Dundee Harbour Trustees against* DAVID HUNTER, Esq., *of Broughty Ferry.*

"INTERLOCUTOR pronounced by Lord Jeffrey, Ordinary, in the process of Declarator depending in the Court of Session, at the instance of the Trustees of the Harbour of Dundee and others, against David Hunter, junior, Esq., of Broughty Ferry, and others.

"*2nd March*, 1841, *Lord Jeffrey*,
"*Act. Cowan, Alt. Neaves.*

"The Lord Ordinary, having heard parties prosecutors on the closed record before answer, remits to Mr. James Jardine, civil engineer in Edinburgh, to inspect the beach at Broughty Ferry, forming the subject of the present action, to hear parties, to make such investigations, and to report in regard to all such matters, as shall appear to him or to either of the parties to be material to all or any of the questions at issue between them, and appoints the reporter along with his report to make such plan or sketch of the said beach and of the adjoining ground or shores as may appear to him to be necessary to understand the matters embraced in the report.

"J. JEFFREY.

"Interlocutor in the action at the instance of Dundee Harbour Commissioners against Hunter, 27th February, 1844. On the motion of the Counsel for the pursuers recommend to Mr. Jardine to make his report *quam primum*.

"A. WOOD."

Edinburgh, May 17, 1845.

IN obedience to the preceding Interlocutors, I met by appointment the Edinburgh and Dundee agents of the parties at Broughty Ferry, on the 23rd of April, 1841, and heard them both *vivâ voce* and in writing, and inspected the beach at Broughty Ferry in dispute, both in their presence and afterwards at different times in the absence of the parties. I further requested the agents of parties to furnish me with lists of the names of such residenters at Broughty Ferry or others as might be able to afford information on the subject, and I have since examined the parties so named to me; and have caused plans of the beach to be constructed, and made inquiry respecting the number and class of the vessels which were in the habit of beaching at Broughty Ferry. The information obtained respecting this last part of the inquiry proved to be defective, as the books of the pursuers kept by the collector of the shore-dues did not distinguish those vessels which beached at Broughty Ferry from those which beached at other places; I was, therefore, under the necessity of requesting the agents of the pursuers to cause the collector of shore-dues, from and after the time of my first inspection, to distinguish those vessels which beached at Broughty Ferry from others, for the purpose of enabling me to make this report, and, having from time to time received copies of such amended lists of vessels, I beg leave to report as follows:—I caused a general plan No. 1, and a particular plan No. 2, to be made for illustrating the matter contained in this report. On the general plan is delineated the north shore of the Tay from Dundee down to Buddon Burn, and on the particular plan the north shore and adjoining roads and streets from the west ferry to Broughty Castle, both inclusive. On inspecting the latter plan it will be observed that the village of Broughty Ferry extends along the shore from Claypots-road down to the precincts of Broughty Castle, of which village the defender is mostly the superior. The sites feued by the defenders at the beach for building are delineated on the plan No. 2 by red lines, and marked Nos. 1, 2, 3, 4, 5, 6, 7, 8, and 9, of which Nos. 1, 2, 3, and 4 are situate within the proposed middle beaching-ground. The works authorised by Parliament to be constructed on the beach at Broughty Ferry are also delineated on the plan No. 2. It will be observed that some parts of these extend beyond spaces proposed to be set aside for vessels beaching, loading, and unloading at the shore. Vessels carrying cargoes of coal, stone, lime, slate for Broughty and the neighbouring country generally beach between the west of Claypots-road, the east of St. Vincent-street, and between high and low water mark, but nearer the former. After due consideration the reporter is humbly of opinion there should be three stations on the shore *ex adverso* of the defenders' ground, left entirely open and free as at present for the beaching of vessels at Broughty Ferry for the purpose of loading and unloading their cargoes for the benefit of the inhabitants in the village and adjoining country.

The first of these beaching stations is at Claypots turnpike-road, bounded seaward by dotted red lines; the eastern portion is opposite the property of the defender, and extends along the same 60 yards. The quantity of materials unloaded and loaded at this station is very considerable, most of which is carted along Claypots turnpike-road to and from the valley of the River Dighty.

The second station is bounded seaward by dotted red lines, EF and GH, between Dundas-street and Fort-street, and is 120 yards in length. This is a very useful station for the inhabitants of the village, and much used for beaching except in westerly winds.

The third station is bounded seaward by the dotted red lines IK and NO, and is likewise opposite the property of the defender. This station is 300 yards long, and is called the *Crook* or *Bight*, and is very important for the beaching of vessels for the country as well as for the village, on account of its good anchorage-ground, and in consequence of the western portions of it being sheltered from the westerly winds, and the eastern portions from the easterly winds.

I am further humbly of opinion that the defender should not be permitted to build on the feus numbered 1, 2, 3, and 4, nor to do anything on the beach between D and F or between H and K, seaward of the highest high-water line, which may in any way impede or diminish the free current of tide to prevent silting up, and to keep all the beach clear.

All which is humbly reported by me,

J. JARDINE.

No. 151.
Stevenson, on the proposed Floating Light at the Entrance to the Firth of Tay.

No. 151.

Report by ROBERT STEVENSON, Esq., C.E., *on the proposed Floating Light at the Entrance to the Firth of Tay.*

Edinburgh, May 19, 1845.

FROM the local situation of the Firth of Tay, and the manner in which its entrance is at present lighted by a distinct set of leading lights erected on either side, in positions calculated to guide the mariner into the mouth of the river and up its course to a safe anchorage, I am of opinion that the proposition of a floating light is quite uncalled for.

No. 151.
Stevenson, on the proposed Floating Light at the Entrance to the Firth of Tay.

Having made a survey of the lower part of the Tay for the Trinity House of Dundee, which was published by order of that House in 1816; and also having had frequent opportunities of navigating that estuary with the master and members of the House at fixing the positions of the Tay lights, and their various improvements, I can state, from personal observation and experience, and from a general knowledge of nearly all the navigable rivers of the United Kingdom, that the Tay is in as perfect a state, both with regard to its light-houses and its system of buoys as any estuary on the British coast.

The leading lights of Buddonness are situated on the northern side of the immediate entrance of the Tay, and when kept *in line* lead over the bar, and guide the pilot into the fairway between the sand-banks at the mouth of the river, which he no sooner enters than he takes up a new course with the higher leading lights *in line*, which are situated on the opposite side of the river, and these guide him above the narrows at Broughty ferry in the most direct and obvious manner.

Now there can be no mistake as to the complete and perfect effect of these lights, as they form sharp marks leading into the buoyed channels. In all ordinary states of the atmosphere the Buddonness or sea-ward lights of Tay are seen at the distance of from nine to twelve miles, and are consequently visible all over St. Andrew's Bay, while the bar of the Tay is only about four miles seaward of these lights. To attempt, therefore, by the establishment of a floating light, to provide against accidents in foggy weather, or against the imprudence of a commander who takes the Tay in an improper state of the weather, would most certainly end in disappointment. Floating lights have, unavoidably little elevation, and their effects are consequently limited, and inferior to what lights on shore admit of being made; they of course lose in power what in certain situations they gain in nearness to the danger. But the lights of Buddonness would in all cases be seen sooner and better than a floating light at the bar, as they command the whole of St. Andrew's Bay.

The Firth and river of Tay are fortunately so situate as to have guide lights upon *terra firma*—an advantage which favourably distinguishes it from the Humber, the Thames, the Mersey, and the Liffey; the distant and tortuous nature of the sandbanks and channels of these navigable tracts render it impossible to have lights upon the shore answerable to their respectivive navigations, and, therefore, recourse must be had to floating lights. But in the navigation of the Tay there is no need to resort to a light afloat, because the two sets of leading lights ashore perfectly answer all the purposes of this estuary, while an additional light would assuredly tend to confusion among the existing lights of the district.

Under these circumstances it is surely unnecessary to create an additional burden upon the trade of the Tay of not less than 1,200*l*., per annum, which is the average cost of maintaining the floating lights on the coast of England.

I am of opinion that much more benefit would be derived by the shipping interest of the Tay by organising a better system of pilotage, placed under the Trinity House of Dundee, and, if possible, to induce mariners bound for the Tay in a foggy and tempestuous state of the weather, to make for the Firth of Forth, and wait a favourable change for entering the Tay. If these two points of *pilotage* and *caution* were attended to, I am confident that few accidents of shipwreck would occur at the entrance of the Tay.

ROBERT STEVENSON.

No. 152.

No. 152.
Complaints of Harbour Dues, and want of proper Landings.

Statement of Complaints of the Inhabitants of Broughty Ferry and neighbourhood, relative to the heavy Shore-dues exacted by the Trustees of the Harbour of Dundee, and as to the want of proper Landings.

October 1. 1846.

I. THAT by the old charter the harbour of Dundee only extended to the West Ferry, and did not include our harbour; but that by subsequent Acts of Parliament they have, by degrees, got the boundary extended to the mouth of the Tay.

II. That by the last obtained Act, in 1836, power was taken to build a harbour at this port, but which they have failed to do. By this Act their rights to build ceased in three years from the date of same. The Trustees, nevertheless, continue to exact the same heavy shore-dues as formerly, without having given any advantage whatever, except mooring three casks with iron rings.

III. That from the depth of water at this port, and from the great facilities of internal carriage, it is extremely well suited for the loading of agricultural produce, and for the landing of coal, lime, manure, bleaching and building materials, &c., which trade would increase to a great extent were we relieved from the expensive shore-dues necessary to build and maintain the harbour at Dundee.

IV. That the shipping is much in danger, being exposed in the open and unprotected beach to all weathers, and that these vessels can only discharge when the tide has left, or nearly left them; that this occasions great expense, delay, and inconvenience to the owners of vessels, and particularly to farmers who send their carts from a distance, they having to be here at a particular time of tide, in which they are often disappointed.

Higher freights have to be paid.

V. That if we were freed from the restraints of Dundee Harbour altogether, a harbour suitable for the wants of this port and adjoining country could and would be erected here at little expense, from the very advantageous natural position of the place, and other favourable circumstances.

Should any further explanations be wished, a deputation will wait on the Commissioners.

CHARLES NORRIE, *Douglas Bleachfield*, and 23 others.

To the Tidal Commissioners.

No. 153.

No. 153.
On the want of defences for protection of Shipping at Broughty Ferry.

On the Want of Defences at Broughty Ferry for the protection of the Shipping, &c.

GENTLEMEN, *Dundee, October* 1, 1846.

FOR a great many years I have, as a Commissioner and a Trustee, been connected with the improvement of the harbour of this place, and therefore am anxiously desirous not only to promote its interests, but also those of the great community with which it is connected.

No. 153.
On the want of defences for protection of Shipping at Broughty Ferry.

I hope therefore that you will excuse the liberty which I take of addressing you, and of submitting for your consideration, as members of the Tidal Commission, the following suggestions, which, were they to be carried into effect, would, in my humble opinion, be beneficial not only to this place but to the nation at large.

You must be aware that Dundee is the principal seat of the linen manufacture in Scotland, and that, during the last 30 years, its trade and population have greatly increased, and from all appearances they are likely to go on extending.

Hence it is of the greatest importance that the persons and property of such a rising community —industrious and enterprising—should be protected. Now, at present I consider that this is not the case; as, were a war to break out, from the great and still extending improvements in steam navigation, there is nothing to prevent a single war steamer from entering the river, bombarding and burning the town, and making her escape, before intelligence could be sent to the nearest station for assistance.

It therefore appears to me that it would be judicious for government to erect batteries at Broughty Ferry, and the opposite side of the river, for the defence of the town. By the erection of works there, the entrance of the river would be completely guarded, and the whole space above would be rendered available for the shelter of vessels, and, if I may use the expression, become a harbour of refuge.

This port might also become a great depôt for the construction and repair of war steamers and other vessels, as there would be ample accommodation for them.

At present we are constructing a large and commodious wet dock, the entrance-lock of which can be made of such a breadth as to admit war steamers and vessels of a large tonnage, as the sill of the lock can be laid so low as to have a great depth of water over it.

There is also ample space on the ground to the south of it for erecting one or more patent slips, of such dimensions as may be thought proper; and also space for foundries and workshops of every description which may be necessary for the manufacture of all articles required in the construction or repair of vessels.

Indeed, without the fear of being considered a partial person, I may affirm that there is no place in the east of Scotland so capable as this is, from its situation and the local advantages of its fine river, of being converted into a safe refuge for vessels of every description, and into a station for the construction and repair both of merchant and of war vessels.

May I therefore hope that you will, after examining the localities of the places mentioned in this communication, take the suggestions thrown out into your serious consideration, and report upon them in such a manner as you shall think fit.

Trusting that my situation as a trustee will plead my apology for addressing you,

I am, &c.,
JOHN STURROCK.

The Tidal Harbours Commissioners.

No. 154.
Complaints of the Harbour and Light Dues.

No. 155.

Complaints of the Edinburgh and Dundee Steam Packet Company of the high Charges for Harbour and Light Dues in the River Tay.

GENTLEMEN,

Chain Pier, October 13, 1846.

I BEG to send you some remarks, premising that I have seen the 'Dundee Courier' report of the meeting. The Edinburgh and Dundee Steam Packet Company's steamer "Britannia" is of iron, and 207 tons register, making trips from Granton to Dundee and back every day at established hours, for six months in summer, and single runs the six winter months, at regular hours. This is the only iron vessel sailing out of Dundee, and the only vessel making a daily passage out of the Tay. She pays in harbour-dues (for the vessel only) computed rates of 34*l.* and 26*l.* a-month, 360*l.* per annum; and for Tay lights 1½*d.* per ton on 207 tons, about 266*l.* per annum. Observing that the summer hours are half-past seven from Granton, and from Dundee at two; and the winter hours from Granton at half-past ten A. M. (formerly half-past eight A. M.), and from Dundee at ten o'clock; it may be said we never see the Tay lights lighted up: in fact, for eight years I have only seen them twice, and for eighteen months in the "Britannia" have never seen them on the regular passage: saw them once when kept out with a fog till morning with a pleasure party. The Tay buoy is a good buoy, but it is adrift at present, said to be blown away down about Arbroath. This season has been very foggy: the arduous duty of being expected to keep regular hours on the daily passage will let your honours appreciate how much I would value a bell-buoy off the Tay; not for fine weather, but for the fog and haze, which frequently obscures the present buoys when one is sometimes within a ship's length of them. I have twice this season gone into the Tay without being able to sight any buoy, guided by sounding and the ripple of the ebb tide. I would not like to venture in on soundings alone in a fog: for ten days running we have gone into the Tay without seeing land after passing Inchkeith, and a bell-buoy would, in my opinion, be very useful to all the trade bound to time; and would frequently have saved me two hours. Even with sailing vessels modern ideas of despatch do not admit of pointing to the Firth of Forth as a shelter for the Dundee trade.

A bell would be heard by all vessels groping for the buoy, and a light would in lighter hazy weather be seen further than a buoy. Besides, with an easterly wind sailing vessels are often tempted to run down to look for the buoys, and not catching sight of them get embayed, or have enough ado to beat off; in hazy weather a vessel is not safe to run in till she sights the Tay lights. These observations are meant to apply to sailing vessels or steamers arriving in the night-time; you will observe from the "Britannia's" hours she is never at or near Dundee after or near sunset. The low-water pier has been of great advantage in summer: having only about two hours to load and discharge, this could not be done at all in the time at the other piers; goods especially could not be landed and loaded, and the transshipping a large number of passengers in small boats is a tedious process, inconvenient to all. From the previous remark that ours is the only vessel sailing daily at a regular hour, you will observe that it has been principally to accommodate the Edinburgh trade it was called for. Besides dues on the vessel, harbour-dues are paid on all goods and cattle even to collie-dogs—a charge made at no other public harbour in Great Britain or America.

APPENDIX C.

DUNDEE.

No. 154.
Complaints of the Harbour and Light Dues.

It is generally supposed that too much money has been laid out at Dundee, too much borrowed, too much interest to pay, and too high dues are consequently necessary. The dues run from 2*s.*, 3*s.*, 4*s.*, 5*s.*, and 6*s.* per ton on goods; an excessive charge! Carriages 12*s.* 6*d.*, 10*s.*, and 8*s.* each, amounting in many cases to a total prohibition; and quite too much for the accommodation afforded; horses 2*s.* 3*d.*, cattle 1*s.* 1*d.*, sporting dogs 10*d.*, collie-dogs, &c., 3½*d.*: as to carriages and horses, these can be travelled through Fife at little more than the Dundee shore-dues, leaving nothing to the ship for freight. It is rare that any one returns after finding what dues they have incurred; the charge is regularly stigmatized by travellers as an imposition. The steamer makes no charge for shepherds' dogs or lap-dogs, but the number of these going ashore is counted by men watching that item, and the attempt to levy the dog-tax is the source of many a quarrel and altercation on board and at the pier, throwing a vexatious and onerous duty on steam-packet masters.

When railways come to be competing with the steam-trade, it will be found to be impossible to maintain these exorbitant dues.

If not out of place here, I would bring under your notice a dangerous rock on the Granton and Dundee track. Leaving Inchkeith distant 14 miles, there are the Elie Vows, half-tide rocks, project-about half a mile into the water; and just in the track of the Shetland, Inverness, Aberdeen, and Dundee steamers, all of which call at Elie, Anstruther, and Crail, on the Fife coast; Elie being just within these rocks—a place of considerable resort in summer.

Numerous shipwrecks take place on it; the last was the "Benledi" steamer, belonging to this Company; the more annoying that, to guard against this very danger, they had put on board, and actually had at the helm at the time, a native of Elie, many years master of the Elie and Leith packet. The Commissioners of Northern Lighthouses have been petitioned to erect a beacon on these rocks, but these gentlemen are mostly sheriffs and provosts, unacquainted with seafaring, and having too much to do with their own avocations I suppose to admit of their attending to this.

I am, &c.,
PETER GREIG.

The Tidal Harbours Commissioners, London.

No. 155.

Complaints by the Edinburgh and Dundee Steam Packet Company of the excessive Charge of Harbour and Light Dues at Dundee.

No. 155.
On the excessive charge of Harbour and Light Dues on Steamers.

GENTLEMEN, *November* 5, 1846.

I BEG to lay before you a representation on behalf of the Edinburgh and Dundee Steam Packet Company. The substance of it was contained in a Memorial to the Board of Trade, April 1845; but as the subject appears to be now before the Government, I respectfully submit it to you now.

The Edinburgh and Dundee passage is a comparatively short one, though it extends out to the sea; for time occupied and distance run, it corresponds nearly to Glasgow and Rothesay, or Glasgow and Ardrossan; though, being more exposed, it requires a larger, abler vessel, and is more thinned of passengers by unfavourable weather.

In the west, as the Clyde, such steamers pay no lights, and but nominal dues to the stone or wooden wharfs they touch at; Glasgow harbour-dues include the cost of deepening and maintaining a long coast of embanking and dredging. Vessels maintaining a regular trade in passengers are obliged, as in our trade particularly, to compete with coaches, and in a few years the railway, and must therefore sail at their regular hour however few passengers come; thus they incur (in our case on a too large vessel, 207 tons register) harbour-dues and lights every day, full or not full; 18 months on the line, the "Britannia" has never been half full, and does not average third or fourth full; her passages, too, are all in the daytime. At Granton the harbour-dues are modified to 50*l.* per annum, but at Dundee the modification is very small. The encouragement, too, of steam navigation in passengers is of very great advantage to the inhabitants and trade of the place, and we are apprehensive that the high rates of lights and harbour-dues will drive the whole trade into the railways now projecting or in progress, and take trade away from the seaports, from the high charges not enabling shipowners to reduce rates and compete with them. Steamers going over the same ground 300 or 400 times a-year, with a cargo of the tenth part of their registered tonnage, at a low freight of 7*s.*, 8*s.*, or 10*s.* a-ton, should not be charged so much as an East or West Indiaman making one or at most two arrivals in a year, with a cargo exceeding the registered tonnage, at 60*s.*, 80*s.*, or 5*l.* freight; and this principle is adopted at Leith docks; after eight voyages no further dock-charge is made.

I beg to submit that this principle is particularly applicable and but fair to other ports, and to the subject of lights.

THOMAS BARCLAY.

The Tidal Harbours Commissioners.

No. 156.

MR. ALLARDICE, *on the want of a Low-water Pier and Improved Ferry.*

No. 156.
Allardice, on the want of a Low-water Pier and Improved Ferry.

GENTLEMEN, *Newport, April* 20, 1847.

IN October last the following letter was published in some of the Dundee newspapers; but as it has not had the desired effect, and I consider it a subject of much importance, I respectfully beg leave to lay it before your Board, having seen no cause to swerve from any of the facts therein stated. On the contrary, several incidents have since occurred to strengthen me in my opinions.

In that letter I made no allusion whatever to the precise spot at which a pier on the south side of the river should be placed; but I now beg leave to state, that, notwithstanding the conflicting evidence on this point, it is my decided opinion that Craig-head is the best situation for it.

From the very moderate winter we have experienced in this quarter, our ferry-boats have kept time very well, no interruption having happened until we were overtaken by the dreadful gale of the 8th instant, when there was no passage for fully four hours, the surge beating so heavily against the piers that it would have been dangerous to make the attempt without a much greater depth of water at the quays than we at present possess.

APPENDIX C.

DUNDEE.

No. 156.
Allardice, on the want of a Low-water Pier and Improved Ferry.

I may also mention that on Thursday last, being the Dundee fast-day, the latest boat grounded in the Craig-pier Channel, where she remained for nearly an hour, with horses, gigs, and nearly 200 passengers on board, who did not get landed till 10 o'clock P.M. Had this happened in a boisterous night, with a sea on, matters might have ended very differently.

Assuredly the course pursued in crossing the river is matter calling loudly for an alteration. Why a circuitous passage, beset with sandbanks and other difficulties, and never performed in shorter time than from 11 to 18 minutes, according to the state of the wind and tide, should be persevered in, I am at a loss to know; whilst within half a mile of it a straight crossing is to be obtained, which could always be accomplished within seven minutes, whatever state the wind and tide might be in.

Since the Government was compelled to take the Tay ferries into their own hands, five years ago, they have, by lowering the fares and carrying out other arrangements, fully doubled the traffic, and greatly enhanced the revenue. As a proof of this it may be stated, that the Dundee Banking Company have been paid up advances and interest amounting to 10,500*l.*, which they had scored off as bad debt; this fact speaks for itself.

A more favourable opportunity than the present cannot possibly occur for effecting a good low-water pier. With three new railways added to the former, all pouring their contents on the ferry, no one, it appears to me, can be deemed over sanguine in supposing that within five years of such improvements being effected the revenue and traffic of the ferry will again be doubled.

Now, after the example set at Burntisland and Granton, it is evident that it would be but a very trifling consideration to five Railway Companies and several Steam Shipping Companies (which often experience great inconvenience at the present quays), aided by the Dundee Harbour Trustees, and the proprietors and trustees of the Tay ferries, to carry out so very desirable and necessary an undertaking.

I am, &c.,
ARCHIBALD ALLARDICE.

To the Tidal Harbours Commissioners, London.

To the Editor of the "Dundee Warder."

SIR,

Easter Newport, October 13, 1846.

IN reference to what transpired at the Tidal Harbours Commissioners' meeting, lately held in Dundee, regarding a low-water pier at that port, I beg leave, through the medium of your journal, to call the attention of the manager and partners of the Dundee, Perth, and London Shipping Company to the subject.

On Friday last their steam-ship the "London" arrived at half-past nine o'clock, and remained at her moorings till nearly three P.M., being about the average time spent by their steamers at the buoy in the river either in leaving or entering the harbour every alternate voyage. Whether the manager or the proprietary ever think of such a waste of time and coal, I need not stop to inquire; but be assured the public have their own thoughts on the subject.

At the Commissioners' meeting, not one of that Company ever ventured to say one word on the propriety of establishing a low-water pier, whilst two of their commanders rather gave evidence against such an erection being carried into effect at the Beacon Rock, the only point at which it can ever be thoroughly accomplished.

In place of supporting such a measure, it was declared by several individuals present that they would rather see the Fowler and Beacon Rocks blown out of the water than allow a chain-pier or low-water jetty to be erected on them, though well calculated by nature for such a purpose.

In answer to a question put to Mr. Leslie, engineer, he clearly gave it as his opinion, that such an erection would not have any prejudicial effect on the entrance of the harbour whatever, provided the works were properly constructed, whilst, if otherwise, it might prove detrimental to the harbour.* Assuredly were the Company to lend their assistance in getting such a pier constructed, it would effect a vast saving to them, and be a great boon at least to the female, frail, and timid part of their passengers, besides conferring an important benefit upon the shippers of live stock, whose property frequently suffers much, especially horses from London, which have often three, six, and even nine hours to stand on board, after a long and boisterous passage of 48 or 50 hours.

I am aware that want of funds on the part of the Dundee Harbour Trustees is pleaded as their excuse; but this ought not to stand in the way, while there are such men as the Duke of Buccleuch, Sir John Gladstone, and other capitalists, who would readily make advances, provided they clearly saw they could realise a handsome return for their money. The formation of such a low-water pier as that exhibited on the harbour plans (with improvements thereon) accompanying the Act of 1836, and sanctioned by Parliament under that Act, would be one of the greatest improvements that could possibly take place at the port of Dundee, although a moderate pontage should have to be levied for its support.

To those who advocate the keeping open of the inner channel to accommodate a few light vessels passing from one dock to another, I can only say, that the Company and the public generally would be great gainers by their complimenting the Harbour Trustees with their old tug, the "Sir William Wallace," which they would no longer require, the Trustees keeping her in proper repair, when she would do all the dragging about the harbour, and even take the Company's half-loaded and half-discharged steamers out and in to dock at high water, thus saving them the expense of keeping the fires in and the steam up while lying outside.

In regard to the Tay ferry-boats, it is evident that the system with them must soon be altered. During the very low tides of last month, the mail was four successive days less or more detained; but this is nothing more than she is now and then accustomed to at low water during spring tides. However, we have railroads now nearly completed in all directions, and this will not be much longer submitted to. Besides, it is quite evident the present ferry-boats are by far too small for the daily increasing traffic, and of course larger boats must be obtained, requiring a greater draft of water;

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* Extract from Mr. Leslie's evidence:—"If the Beacon Rocks could be removed at a moderate expense, it would be a great matter; but the expense would be very serious; and unless they could remove them down to the level of the we dock, they would be better as they are.".

APPENDIX C.

DUNDEE.

No. 156.
Letters relative to a Low-water Pier.

but it appears by the evidence given by the Harbour Master, that the Craig Pier has more need to be shortened than lengthened. Where, then, are the ferry-boats to take on board and land their passengers, coaches, carriages, carts, cattle, &c.? Assuredly not at the Craig Pier in its present state.

When these remarks fall under the notice of the manager and partners of the London Shipping Company, they will do well to convene themselves, along with the owners of others steamers trading to and from the port, the Harbour Trustees, the proprietary of the Tay ferries, together with those interested in the various railways, and endeavour, if they possibly can, to devise and mature beneficial measures among them. Those gentlemen who have such an hostility to the Fowler and Beacon Rocks, I would advise to take a peep at Leith harbour. There they will find the good folks have been labouring at a breakwater or low-water pier (now upwards of a mile in length) for many long years, very similar to such a one as is required at Dundee, but which could be built in eighteen months for a mere tithe of the money the Leith one has cost, and be far more efficient.

To conclude. All must be aware of the intentions of the Edinburgh and Northern Railway Company in regard to ferry accommodation at the lower ferries, which, should they succeed in, and should the opposition threatened to the London Shipping Company be carried into execution, may at no distant period read to them and the port of Dundee such a lesson at Broughty Ferry as the *town* and *trade* of Leith have been taught at Newhaven and Granton.

I am, &c.,
A DUNDEE BURGESS.

No. 157.

No. 157.
Decision of the Lord Ordinary (Lindsay *v.* Harbour Trustees) and Lindsay's Petition.

Interlocutor and Note in Suspension and Interdict, J. M. Lindsay, &c. v. *The Harbour Trustees of Dundee.*

November 9, 1846.

THE Lord Ordinary having considered the note and answers, and heard counsel thereon, in respect the complainer has set forth no sufficient legal title to challenge the proceedings complained of, refuses the note, finds the respondents entitled to expenses, and remits the account thereof when lodged to the auditor to tax and report.

P. ROBERTSON.

NOTE.—The question raised on the merits in this Sepension and Interdict regards the legality of a grant of 500*l.* out of the funds of the harbour trust of Dundee, towards the erection of a triumphal arch, in honour of Her Majesty's landing at that port in the year 1844. The grant is justified on the ground that the sum subscribed is not more than was necessary for the erection of a proper gateway, to enclose one of the docks; and although some of the trustees recently disapproved of the grant, it has been sanctioned by a majority of that body. But the preliminary question is, whether the complainer has any title to inquire into the conduct of the harbour trustees? and if he have not, then it is plain that the merits of the grant cannot be determined in this case.

In discussing the question of title, it is of course to be assumed that the misappropriation can be made out. The complainer states three characters in which he sues. First, as an insurance-agent, and thereby interested in the general property of the port; secondly, as a burgess of Dundee, which gives him still stronger interest; and, thirdly, as a member of the guildry, which corporation, along with certain other public bodies, sends representatives to the harbour trust. The Lord Ordinary does not consider that any of these characters gives a legal title. Even if the complainer had been a rate-payer, which is certainly stronger than the position of an insurance broker, or a burgess, this, under authority of the decision in the case of Ewing *v.* The Glasgow Commissioners of Police, 16th August, 1839; Maclean and Robinson's Reports, House of Lords, page 847, would not have entitled him to complain of alleged misapplication of funds. Nor, as was decided in the case of the burgesses against the magistrates of Inverary, 14 December, 1820, could he, as a burgess, complain at common law, even of the misapplication of burgh funds. His title as one of the guildry, however, was mainly relied on, because that body elects five merchant members to be harbour trustees. If this gives a title, it would confer the same right on the whole members of the Town Council, of the Nine Incorporated Trades, of the Three United Trades, of those entitled to vote at the Michaelmas county meeting, and the members of the Seaman's Fraternity, for all these bodies elect Harbour Commissioners. The Lord Ordinary does not consider that being a member of such elective body gives that direct and immediate interest which entitles a party not to complain of anything done by the corporation of which he is a member, or by the representative of that corporation, but of the conduct of the statutory body to whom the corporation sends a representative. The case of the Trinity House of Leith *v.* the Magistrates of Edinburgh, 6th February, 1829, Shaw 7, p. 374, seems conclusive on this head.

(Initialed) P. R.

The Petition of John Mackenzie Lindsay, Merchant and Insurance Agent, Dundee, to the House of Commons, Humbly sheweth,

Dundee, January 13, 1847.

"That by statute Queen Victoria 6 & 7, cap. 83, a Board of 21 trustees are appointed to collect the harbour dues of Dundee, and to apply the same to improve the harbour, and towards, first, the liquidation of the debt contracted for the work, and to continue to improve the harbour; and then, as soon as the debt can be paid off, to reduce the said shore dues, payable by the inhabitants and by the public.

"That it appearing to your petitioner and others that a majority of the said trustees were proceeding to act contrary to the Act of Parliament by which they are appointed, by applying the harbour funds towards purposes never contemplated by the statute, viz., voting away 500*l.* towards the erection of a triumphal arch, and laying out nearly as much in bringing up foundations for the said arch, which would be an obstruction to the free access so desirable to be maintained, and worse than useless, as causing a dangerous interruption to the traffic, and which misapplication of the trust funds would retard and delay the reduction of the tax, remonstrances against the said intended misapplication were made, but all in vain.

"That when the Tidal Commissioner held a public court in Dundee, he asked the clerk of the harbour trustees, 'If the trustees were to lay out the funds improperly, who possesses the power to control them?' and the clerk assured him that such control was vested in the Court of Session.

"Your petitioner, accordingly, applied to the Court of Session to prevent the misapplication of the funds of the harbour for such purposes; when, instead of entering into the merits of the question, the trustees denied the right of your petitioner to question their conduct; and the Lord Ordinary, Robertson (contrary to common sense and justice), decreed that your petitioner, although contributing to the said harbour dues, had no legal title to question the acts of the Harbour Board, and ordained him to pay the costs of the action.

"Your petitioner, therefore, prays that you will please to adopt such measures as shall give power to some competent Board to compel the strict adherence of the Harbour Trustees to the Act of Parliament, and that the majority of the Harbour Trustees who have misapplied the funds may be obliged to replace to the funds of the harbour the 1200*l.*, or such other amount as it may be found they have misapplied as aforesaid; as also to repay to your petitioner the 120*l.* expended in expenses at law, in the endeavour to prevent the trustees from that wasteful and illegal application of the harbour funds.

APPENDIX C.

DUNDEE.

No. 157.
Decision of the Lord Ordinary (Lindsay *v.* Harbour Trustees) and Lindsay's Petition.

"Your petitioner observes, by the published resolutions of the Board, that the Harbour Trustees wish to be exempted from that salutary and highly necessary control as will exist if the contemplated Conservancy Bill shall pass into law; whilst your petitioner submits that the conduct of the majority of the Board, in their obstinate misapplication of the harbour funds, and the course adopted by them in the Court of Session to evade all check and control, evinces the strong necessity in this amongst many other instances of misapplication for some enactment of a Conservancy Bill which may prevent the abuse of powers granted to trustees by Parliament for the public benefit.

"Your petitioner also humbly sheweth, that the interests of the fishing town of Broughty Ferry have, in his opinion, been sacrificed for the benefit of Dundee Harbour, and by the want of such independent control as the Conservancy Bill would afford; and that, in the opinion of your petitioner, the continuance of the many evils arising here and elsewhere from the prevalance of local and sinister interest would not be allowed under such a general Conservancy Board as the proposed Act would establish.

"Your petitioner also submits that many wrecks and losses occur in the river Tay; and, in the opinion of your petitioner, great benefit to the navigation would be speedily obtained if the prevailing local interest were properly controlled and superintended by an intelligent and impartial Conservancy Board, having all the aid that science can afford to them in the various works to be done in the river and harbour.

"JOHN M. LINDSAY."

No. 158.
Charges for Pilotage and Tay Lights.

No. 158.

CHARGES for PILOTAGE and TAY LIGHTS.

Return of Pilotage paid for British and Foreign Vessels, for the Years 1843 and 1844, *at Dundee.*

1843			1844		
Vessels.		Pilotage Charges	Vessels.		Pilotage Charges.
		£. s. d.			£. s. d.
British . .	366	403 5 1	British . .	359	472 17 8
Foreign . .	155	209 2 7	Foreign . .	189	254 6 2
Totals . .	521	612 7 8	. . . .	548	727 3 10

The employment of pilots being optional, accounts for the amount of pilotage dues received from foreign, being so considerable when compared with the receipts from British, vessels, the river navigation being generally known to the British shipmasters frequenting this port.

LANCEMAN WEBSTER, *Pilot Master.*

Return of Light Dues levied for Tay Lights, on British and Foreign Vessels, for the Years 1843–44, at Dundee, made by the Box Master.

	1843	1844
	£. s. d.	£. s. d.
British vessels	1242 6 4	1184 15 1
Foreign ,, ...	62 7 4	79 10 8
Add sum paid by Trinity House . .	62 7 4	79 10 8
	1367 1 0	1343 16 5

The charge for lights is the same on British as on foreign ships; but upon the latter, a sum equal to that levied is allowed to the Corporation of the Fraternity of Masters and Seamen of Dundee by the Trinity House, London.

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No. 159.

Return of Income and Expenditure for the Years 1841–2, 1842–3, 1843–4.

INCOME.

Heads of Income.	1841–2	1842–3	1843–4
	£ s. d.	£ s. d.	£ s. d.
Shore dues	15,087 12 0	14,061 8 8	20,750 17 7
Graving and floating dock ditto	588 9 7	592 12 8	496 4 10
Rents	1,625 9 10	1,722 15 10	1,730 11 5
Repairing slip, dues	263 15 6	295 11 9	298 7 2
Shed ditto	183 4 10	140 0 2	163 12 5
Crane ditto	151 12 6	108 7 5	114 18 6
Steel-yard ditto	65 4 5	80 2 2	90 2 6
Careening beach ditto . .	32 8 9	34 0 10	27 19 8
Ballast tub	0 10 1	..	0 8 7
Harbour manure	132 0 0	132 0 0	132 0 0
Police assessments	84 19 9	80 4 2	80 12 0
Sale of stones, works injured, &c.	237 8 4	82 18 2	31 10 6
Fines	0 10 0	0 10 0	..
Total	18,443 0 7	17,331 0 10	23,909 2 9

EXPENDITURE.

Heads of Expenditure.	1841–2	1842–3	1843–4
	£ s. d.	£ s. d.	£ s. d.
Salaries	1,874 15 8	1,526 2 5	1,643 4 10
Extending and improving harbour	2,977 6 3	3,279 4 0	2,818 4 0
Trustees new buildings . .	2,383 3 9	1,689 14 11	604 6 11
Collecting revenue	645 18 11	585 6 4	558 3 10
Lighting	178 18 6	168 3 8	185 15 9
Police	418 4 0	395 9 11	390 1 1
Law expenses	697 14 11	421 17 2	211 8 10
Expense of new Act . .	..	373 6 9	1,993 1 4
Rates, taxes, and insurance	102 13 4	127 0 4	908 5 7
Interest of debt	10,833 0 8	11,375 3 11	10,865 10 5
Expense of loans	113 0 8	37 9 1	709 19 7
Sinking fund	..	..	5,750 0 0
Total	20,224 17 0	19,978 18 6	26,638 2 2

The dues are levied under Acts 55 Geo. III., c. 97; 59 Geo. III., c. 103; 12 Geo. IV., c. 119; 6 Will. IV., c. 61; 6 & 7 Vict., c. 83.
By the last-mentioned Act £5,750 is required to be applied yearly towards the liquidation of the debt.
The debt due on the 1st January, 1846, was 224,150*l.*

JOHN CAIRNCROSS, *Treasurer.*
JAMES BROWN, *Chairman.*
GEO. MILNE, *Clerk.*

No. 160.

List of Wrecks at the Entrance of the River Tay, from 1825 to 1848.

Date.	Name.	Rig.	Cargo.	Belonging to	From	Bound to	Wind	Weather	Exact spot where wrecked	No. of Lives lost.	Remarks Supposed cause of Wreck? Had Pilot on board?
1825	Fancy	Schooner	..	Dundee	Newcastle	Dundee	E	Strong gale	On the elbow end of Abertay Sands	1	Had no pilot on board
"	Speedwell	Brig	..	Newcastle	..	..	..	..	..	All.	
"	Mackerel	Brig	..	Sunderland	.	..	.	..	.	All	
"	Betsy and Mary	Brig	..	Yarmouth							
"	Fidelity	Sloop	..	Dundee							
1828	Margaret	Sloop									
"	Euphan Lowden	Sloop									
1829	Childe Harold	Schooner	Flax	Dundee	St. Petersburg	Dundee	..	..	Abertay Sands	1	Master killed by falling of foremast. No pilot
"	Davna	Sloop	.	.	..	..	..	..	..	All	
1830	Scotia	Brig	Wheat	Dundee	Dantzic	Dundee	.		Abertay Sands	4	No pilot. Sunk in the river
"	Betsy	Sloop									
1834		Galliot	..	[illegible]	..	.					Name unknown.
1835	Agnes	Schooner	Coal	Dundee	..		N W	Moderate	Coal Hill * Abertay Sands	.	Vessel totally lost.
"	Industry	Sloop	Coal	Newcastle	.	Dundee	S.E.	Fresh gale	Buddon Ness	1	One man saved by life-boat
"	Alert	Sloop	..	Dunbar	.	.	N W	Fresh breeze	North Gaa	..	Totally lost. First struck on Coal Hill.
"	Two Brothers	Sloop	.		..	..		..	..	1	Master.
"	Lol	Schooner	Bale goods	Dundee	Dundee	Glasgow	S.E.	Strong gale			
1836	Fama	Schooner	Corn	Boston	Dundee	Boston	S S.W	Fresh	Coal Hill, Abertay Sands.		
"	Mary	Brig	Flax & Hemp	Dundee	Riga	Dundee	S.E	Squally with snow	Coal Hill, Abertay Sands.	All	No pilot.
"	Providence	Sloop	.	Terry Barn	..	..	N W.	Strong gale	Struck on South Gaa	..	Foundered.
1837	Grahame	Sloop	.	Perth	..	..	N E	Squally	..	All	Sunk in a squall off the mouth of the River
"	Jean	Sloop	..	Dundee	.	..	N.E.	Squally	Struck on Tay Bank.		
"	Jane	Sloop	Potatoes	Berwick	Perth	London	S	Squally	Coal Hill, Abertay	All	No pilot.
"	St. Neil	Barque	Flax	St. Petersburg	St. Petersburg	Dundee	S S.E.	Squally	Abertay Bank	.	Crew saved by means of life-boat.
"	Sisters	Sloop	..	Kirkcaldy	.	..	S.E.	Squally	Coal Hill, Abertay	.	Ditto. Vessel got off
"	Tolenden	Galliot	..	Copenhagen	.	..	..	..	.	.	Ditto.
"	Isabella Forbes	Schooner	Goods	Perth	Rotterdam	Frith	..		.	1	Vessel got off
"	Thistle	Brig	Coal	Dundee	Newcastle	Dundee	.	..	..	1	Ditto. Crew saved by life-boat
1838	Nechus	Schooner	..	Copenhagen							
"	Surjens	Schooner	.	..	..	..	..	.	..	..	Saved by life-boat.
"	Ranger	Schooner		Perth	..	.	.	..	..	..	Ditto.
1840	Eliza	Sloop									
1841	Agnes	..	..	..	The Forth	Dundee	.	.	Off Dundee.	All	
"	Vestal	Brig	Wine	Leith	Oporto	Dundee	.		Abertay Banks	..	No pilot
1843	Albion	.	.	..	Newcastle	Perth		.	Entrance of Tay		
1844	Spray	Schooner	Coal	Dundee	Newcastle	Dundee	S B	Snow	..	1	
"	Hope	Sloop	Grain	Dundee	Dundee						
1848	Martin	Brig	Coal	Dundee	Newcastle	Dundee	S E.	.	.	..	No pilot
"	Fortune	Sloop	.	..	.	..	..	..	..	.	Saved in their own boat. No pilot.
"	Matheola	..	Guano	Aberdeen	Ichaboe	.	.	.	Abertay Sands	.	Had a Leith pilot on board.
"	Five Brothers	Brig	..	Perth	..	.	.	.	Gaa Sands		

Making 41 vessels in 21 years. The list of Wrecks between the years 1825 and 1837, furnished by Lieutenant E. [illegible], R.N., to the Tidal Harbours Commissioners, is far from complete; during this period many more vessels have been on shore, but got off with more or less damage.

J. N. Sharp, *Harbour Master*.

* The Coal Hill is the name given to the high part of the Abertay Sand just to the westward of the Elbow End buoy.

APPENDIX C.

ARBROATH.

No. 161.
Evidence taken on the 30th September, 1846.

ARBROATH.

No. 161.

Examining Commissioner—Captain WASHINGTON, R.N., F.R.S., assisted by Captain VETCH, R.E., F.R.S., Admiralty Engineer.

Present:—Provost GIBSON; W. F. LINDSAY CARNEGIE, Esq.; Mr. ALEX. MANN; Mr. D. LOUSON; Mr. W. CARGILL; Mr. JAMES LESLIE, C.E.; Mr. I. MACDONALD; Mr. KIDD, Harbour-master, &c.

[*Plans of Arbroath, by Mr. Leslie, on a large scale, showing the New Works, and the Admiralty Survey of the harbour and adjoining coast, by Captain Slater, R.N., in* 1833, *were laid on the table.*]

THE Commissioners having, in company with some of the harbour trustees, the engineer and harbour-master, visited and inspected the harbour and piers, and caused to be pointed out to them the new works and proposed additions, repaired to the Town Hall, where the proceedings were opened by reading the Royal Commission.

They then stated that this was an inquiry into the past and present state of the harbour of Arbroath, and its capabilities for further improvement; that the meeting was public, and that after the examination of the officers of the Trust, they would be ready to hear the remarks and opinions of any pilot, mariner, or fisherman, or, in short, of any one who took an interest in the welfare of the port.

MR. JOHN MACDONALD examined—Is clerk to the harbour trustees since 1839. Prior to the Act of 2nd Vict. cap 16, the harbour of Arbroath was governed by the magistrates and town council of the burgh, under a charter of James VI., and its revenues were then applied to the ordinary municipal affairs of the burgh, as watching, lighting, paving, &c. In 1838 the inhabitants resolved to adopt the provisions of the General Police Act, and levy a rate for the above purposes, leaving the harbour revenue to be appropriated solely for harbour purposes, with the exception of 10,000*l.* to be paid to the town council for the old harbour. The new Act vested the harbour in 19 trustees, and gave power to raise the sum of 50,000*l.* With this money the trustees have carried out several useful works, under the superintendence of Mr. James Leslie, of Dundee; they have repaired and enlarged the harbour, constructed a sea wall, and a new outer harbour, and other works, whereby the accommodation for the shipping and trade of the port has been more than doubled. In doing this for the public good, they have incurred a debt of 54,012*l.*, half of which pays interest at 5 per cent., and half 4 per cent. to creditors in the town, who liberally came forward and gave their personal guarantee for the bank credit obtained by the trustees. These obligations, to the extent of 24,000*l.*, still exist undischarged. The total sum expended in the harbour and works since 1839 is 58,000*l.* The deepening of the harbour, its entrance and approaches, to a depth of 3 feet, still remains to be done, but the trustees have exhausted their means, and earnestly hope for some slight Government aid to assist them in their present difficulty; as deepening the entrance would increase the traffic, and thus the dues would pay off the debt.

The old harbour was built about the year 1725, and at that time the shore dues amounted only to 25*l.*; the arrivals were a few small coasters, and the population of the town was under 2500 persons. The revenue for 1845 was 3271*l.*; the arrivals, 848 vessels, of which 79 were from foreign; the aggregate tonnage, 47,607 tons; the population has increased to 16,000, and the town has become the seat of extensive manufactures. The seafaring population may be estimated at 300, employed in vessels trading to foreign; 400 in coasters, and 120 fishermen, total 820. There is an extensive white fishery employing 20 boats; also a life-boat and mortar, in case of wreck. There is a patent slip; 3 building yards, with 5 building slips, giving employment to 50 shipwrights; but no graving-dock. A railroad communicates with Dundee, Forfar, and Aberdeen. Supplies of all sorts, provisions, water, and coal, are abundant and cheap. Produced the minute-book, letter-book, and account-book of the trust, and stated that the accounts were audited by an independent auditor appointed for the purpose, and an abstract was printed and published annually.

The COMMISSIONERS, having examined the harbour books, said that as far as a cursory inspection would enable them to judge, the books and accounts appeared to be properly kept and in good order; and they must add, that the very complete manner in which the several documents, plans, and answers to printed queries had been furnished to the Commission, was highly creditable to the trustees and to their zealous secretary.

Mr. JAMES LESLIE, C.E.—The recent harbour works at Arbroath were carried out under his superintendence. The original works were designed by Gibb of Aberdeen; but the outer sea wall, &c., was built from his design on a foundation chiefly of rock. The area of the old inner harbour is 2 acres, and of the new inner harbour 3 acres; of the new outer, 1 acre, total, 6 acres; and if the space within the outer breakwater be included, total, 7 acres. The whole extent of wharfage is 800 yards; without the harbour a rocky flat, dry at low water, extends 230 yards to low-water mark. At one cable's length without this spot is a depth of 18 feet, and 6 fathoms at a quarter of a mile beyond. Two dangerous rocks, called the Knuckle Rock and Cheek Bush, which dry at very low springs, should be blasted away, or have beacons erected on them. The rise of tide is 16 feet in springs, when there is a depth of 12 feet into the harbour; neaps rise to 9 feet. The outer entrance of the harbour is 100 feet wide, and faces south by compass; the inner entrance to the new harbour is 50 feet wide, and to the old harbour, 27 feet. The piers are built of red sandstone rubble, faced with ashlar, laid on a foundation of rock, so that they will admit of the harbour being dredged; the stones vary from 5 to 30 cubic feet each, and the pitchers are treenailed or dovetailed together: the outer or sea wall is nearly upright. There is a good deal of deposit in the harbour, fully six inches per annum. The plans for improvement, however, are far from having been completely carried out. The intention was to convert the old harbour into a floating basin; to remove the old piers, and to deepen the entrance; this last measure is of the utmost importance, and should be accomplished at almost any sacrifice; it would be necessary to clear a channel 100 feet wide, and 3 feet deep, for a length of 230 yards; the soil is a soft sandstone, with numerous boulder-stones, many of which might be lifted without much difficulty. This channel might be formed for about 10,000*l.*, and if a depth of 3 feet were gained, thus giving 15 feet at the entrance at high water springs, and 12

APPENDIX C.

ARBROATH.

No. 161.
Evidence taken on the 30th September, 1846.

feet at neap tides, witness is of opinion that it would double the traffic of the port. Such a harbour would be a great boon on this part of the coast.

MR. KIND—Has been harbour-master for ten years. During that period the harbour has been immensely improved; the arrivals amounted last year to 848 vessels, of which 79 were from foreign, having an aggregate burthen of 47,607 tons; and the revenue reached 3271*l.* 18*s.* 5*d.*, showing an increase of 335*l.* over the year 1844. The harbour has proved very useful at times; recollects several fishing boats from Frazerburgh driven past all the harbours to the northward, and saved at Arbroath. There is very great need of a low-water harbour on the east coast of Scotland: in the year 1800 not less than 13 vessels were wrecked in one night, within 6 miles of Arbroath. Is of opinion that deepening the approaches and entrance at least 3 feet, is the great improvement wanted, and, without it, what has been done is in a great measure unavailable. The outer harbour must be deepened, the old pier removed, and the new middle quay wall built: a sluice introduced into the new harbour, in connexion with the Brothok, might help to scour away the silt: this mode has been found very beneficial in the old harbour, and is used at every spring tide. No steam dredge has ever been applied to the harbour or the approaches. Vessels, once inside, lie safely; the Bell Rock tender is stationed here, and supplies the lighthouses with what is required.

WITNESS is also pilot-master; there are 20 pilots; they pass an examination before him and the trustees, and receive license; they are paid by the job, according to a fixed rate, and not by salary. There is one tide light at the pier head; it is a French lens and lighted by gas; it is only shown when a vessel is off the port.

The COMMISSIONERS, having inquired if any one present had any remarks to make or suggestions to offer, said that as far as they could judge, the exertions made by the trustees, seconded by the inhabitants, to improve their harbour had not been exceeded by any port in Scotland, and it was much to be regretted that, when it appeared on all hands that the small sum of 10,000*l.* would double the value of the works already carried out, the Treasury should have found itself obliged to decline acceding to the prayer of the memorial, in which the trustees had so fully and fairly stated their case.

No. 162.

No. 162.
Return of Acts and Plan, &c.

Return to Order of the House of Commons of August 9, 1844.

Titles of the several Acts of Parliament, or Charters and Commissions, under which Commissioners have acted, and now act.	Copies of all Maps of the Harbour in possession of the Commissioners.	Reports made by all Engineers or other Officers, respecting the Port or Harbour.	Copies of Complaints, made to the Commissioners of the Harbour, of its defects.
2nd Victoria, cap. 16. "An Act for extending, improving, regulating, and managing the Harbour of the Royal Burgh of Aberbrothwick, in the Forfar.	No. 1.—Plan of the Town, with a delineation thereon of the Harbour, as it will be when the plan for the improvement and enlargement of the Harbour, as sanctioned by Parliament, is fully executed. No. 2.—Plan of the Harbour of Abroath showing its present state.	There are not any Reports made by Engineers or other Officers, in the possession of the Harbour Commissioners.	No complaints, in writing, have been made to the Commissioners of this Harbour; verbal complaints are, however, to my knowledge, being constantly made of the want of a sufficient depth of water, which, if not remedied, must materially injure the trade of the port: many even of the smaller class of vessels, of from 60 to 70 tons burthen, having to anchor for days in the river Tay (the navigation of which is very dangerous), to await the rise of the tides, before they can enter this Harbour. Letter from the Clerks to the Parliamentary Trustees of Harbour, enclosed.

F. MARTIN, *Collector.*

Custom-house, Arbroath, 3rd March, 1845.

No. 163.

No. 163.
Memorial of Magistrates and Town Council to the Treasury.

Memorial of the Magistrates and Town Council, Harbour Commissioners, Shipowners, and Merchants, of Arbroath, to the Lords of the Treasury.

SHEWETH,

THAT the Memorialists have long been of opinion that, from the great increase which has taken place in the trade of Arbroath, they are justly entitled to a full and complete Customs' Establishment, and to be raised to the status of a free and independent port.

That your Petitioners found their claim to the enjoyment of this privilege on the entirely altered circumstances of the town of the present day, as compared with what it was when it became a creek or member of the port of Montrose. At that period, though a Royal Burgh, it was little other than a fishing village, destitute of trade and manufactures, with a poor and scanty population. It is now a flourishing town, the seat of extensive manufactures, with a population exceeding that of the head port.

In corroboration of this statement, the Memorialists shall take leave to lay before your Lordships several statistical details, which they humbly conceive may be sufficient to justify their application for a dismemberment from Montrose. And first, they respectfully submit an account of the number of

APPENDIX C.

ARBROATH.

No. 163.
Memorial of Magistrates and Town Council to the Treasury.

vessels reported inwards from foreign ports, with the amount of duties collected in the following years, viz.—

Year ending 5th January,

1836		1837		1838		1839		1840		1841		1842		1843		1844	
No.	Duties.	No.	Duties.	No.	Duties.	No.	Duties.	No.	Duties.	No.	Duties.	No.	Duties.	No.	Duties	No.	Duties.
	£.		£.		£.		£.		£.		£.		£.		£.		£.
51	1916	81	3138	82	6584	94	7493	89	8116	101	8725	85	6538	75	4515	84	4265

It will thus be seen, that from 1836 to 1841 inclusive, the increase was steady and progressive, the amount of duties in that period being considerably more than quadrupled. The falling off since 1841 is to be attributed to the very depressed state of trade generally throughout the country, and from which Arbroath has suffered in common with other manufacturing towns. But the principal cause of the decrease in the two last-mentioned years arises from the alteration in the tariff, and more especially from the falling off in the importation of timber, occasioned by the reduction of duty, there having been only 843 loads in the years 1843-4, against 3618 loads in the two years immediately preceding.

In the article of flax, Arbroath is the second import town in Scotland, Dundee alone being greater. In the number of hides imported, it is exceeded only by Leith. In several other articles it will stand a comparison with many towns which can boast of an independent custom-house; but the above have been selected because the Memorialists are in possession of authentic documents to verify the accuracy of their statements, and because flax is the raw material employed in the staple manufacture of the town and neighbourhood; the total quantity of which, imported during the year ending 15th October last, including hemp and codilla, was 149,220 hundred-weights. In the spinning of this raw material, and of the additional supplies derived from Dundee and brought coastwise, there are steam-engines employed of 350 horse power, which, with the bleaching, manufacturing, and other processes carried on, give employment to several thousand individuals.

But there is no fact which more satisfactorily establishes the progressive improvement in the trade of the town, than the advance which has taken place in the revenue collected for harbour dues. In 1819, the amount was 679*l*., while in 1843 it was 3050*l*.; and this in the face of the unfavourable state of trade already referred to.

Nor is the growing prosperity of Arbroath manifested by these statistics only. It is not less strikingly exhibited in the great public improvements which of late years have been executed therein, and which have distinguished the town as a place of singular enterprise and public spirit. In addition to a railway, connecting it with the large manufacturing town of Dundee, there is a similar means of communication with the county town of Forfar, distant fifteen miles, thus connecting Arbroath with the interior, and rendering it, in point of fact, the sea-port of Forfar and Kirriemuir, and a large portion of the fertile valley of Strathmore, besides the intermediate district.

But highly beneficial as these are, as important auxiliaries in promoting and facilitating trade, their utility would have been greatly impaired without adequate harbour accommodation. In this respect, Arbroath was avowedly deficient; and the inhabitants, alive to the necessity of removing so serious a drawback to the prosperity of the town, applied for and obtained an Act of Parliament, in the session of 1839, for the enlargement and improvement of the harbour. With the German Ocean to contend against, a grant of public money might have been applied for, as in similar cases elsewhere, before commencing so arduous an undertaking; but the Petitioners are proud to say, that a spacious new harbour has been constructed, without one shilling being derived from the Exchequer, although no less than *fifty thousand pounds* have been expended on the works. This harbour is now open for shipping, and being adapted for a larger class of vessels than the old one, and possessing many other advantages, it is impossible to estimate too highly this valuable accession to the maritime importance of the town. The Memorialists have watched with deep anxiety the progress and successful completion of this great and hazardous undertaking; and being now desirous to make it known to the public, they earnestly long, at the same time, to have it in their power to announce Arbroath as an independent port.

And to show that, in humbly soliciting this boon, your Petitioners are asking nothing unreasonable, they take leave respectfully to submit to your Lordships, in contrast with Arbroath, a list of twelve head ports in Scotland, with the amount of revenue collected at each in the year 1841, together with the population as taken at last census, viz.:—

Names.	Amount of Duties.	Population.
Creek, Arbroath	£8725	14,568
Port of Kirkaldy	4247	9,778
,, Inverness	4185	11,568
,, Borrowstowness . . .	4073	..
,, Irvine	3711	7,313
,, Banff	1698	5,309
,, Ayr	1463	15,749
,, Wick	1232	5,522
,, Campbelltown	934	6,782
,, Kirkwall	771	3,046
,, Stranraer	653	4,878
,, Stornoway	349	..
,, Lerwick	153	..

From this statement, which is taken from the latest list published in the "Edinburgh Almanac" for the current year, it will be seen that the amount of duties levied at Arbroath is upwards of four times more than the average of these twelve ports, with all their creeks and dependencies included, being 100 per cent. more than the highest, and 5000 per cent. greater than the lowest. As respects population, the comparison is equally favourable to Arbroath, the port of Ayr alone being somewhat higher, while all the rest are vastly inferior.

Other statements might be brought forward to establish the fact of the manufacturing, commercial,

APPENDIX C.

ARBROATH.

No. 163.
Memorial of Magisgistrates and Town Council to the Treasury.

and general importance of this town as compared with other places which rank as head ports, particularly in regard to its trade in corn, the quantity of articles of cast iron exported, and to the quantity of coals, lime, pavement, and other goods and merchandize, brought and carried coastwise; but the Memorialists humbly trust that enough has been stated to satisfy your Lordships that the period has at length arrived for dissevering the connection with Montrose. That town, it is admitted, exceeds Arbroath in the amount of revenue, because the former has the privilege of a bonded warehouse for tobacco, which is denied to the latter, but in general trade it is not to be disputed that the head port is in arrear of its once inconsiderable creek. But there is no wish to disparage Montrose. Both towns are in a progressive state of improvement, and each is entitled to a customs' establishment independent of the other.

Finally, it is humbly submitted, that the conversion of this creek into a port would add very little to the expense of collecting the revenue. On the separation of Arbroath from Montrose, the latter, as a matter of course, would stand lower in the scale of ports; and the salaries of the principal officers, on the death, retirement, or removal of the present incumbents, would necessarily be reduced, which reduction would go towards defraying any additional charges that might be rendered unavoidable by the change. The Petitioners look forward with confidence, however, to your Lordships considering the matter in all its bearings, and that you will act in reference thereto with that liberality which is known to characterize your Right Honourable Board in whatever relates to the facilities and accommodation to be afforded to trade.

It may be almost superfluous to add, that the concession of the boon now prayed for would be hailed by the Petitioners and the inhabitants at large as a signal favour. At present, this town, in a maritime sense, may be considered as virtually swamped in that of the head port. It is necessary to register the shipping at Montrose, which town must also, under pain of seizure, be painted in legible characters on the sterns of the Arbroath vessels. It can readily be believed, that much inconvenience and confusion thence arise, and that this circumstance alone is an unceasing source of irritation and annoyance both at home and abroad. To the shipping interest in particular, therefore, an independent custom-house would be invaluable, and to the trade generally its advantages would be many and obvious; not the least of which would be, the facility it would afford of correspondence direct with the Board in London, at present rendered tedious and tantalizing by having to be conducted through the circuitous medium of Montrose. The maritime importance of the town would be vastly increased, and more widely extended, by its advancement from a *creek* to a *port;* and in connection with the enlarged accommodation for shipping afforded by the new harbour, together with the railways already referred to, and other local advantages, Arbroath would be raised to that status amongst the sea-ports in Scotland to which it is so justly entitled.

May it, therefore, please your Lordships, for the reasons herein set forth, to erect Arbroath into an independent port, with all the rights and privileges appertaining thereto, and your Petitioners will ever pray.

Arbroath, April, 1844.

No. 164.

No. 164.
Memorial of Harbour Trustees to the Tidal Harbour Commissioners.

The Memorial of the Trustees of the Harbour of Aberbrothwick to the Tidal Harbours Commissioners.

HUMBLY SHEWETH,

1. THAT the Memorialists have, by persevering exertion and at considerable expense, succeeded in enlarging and greatly improving the harbour of Aberbrothwick, but they find themselves, from the want of funds, altogether unable to accomplish important parts of their plan. There are still works to complete, particularly the deepening of the harbour and its entrance and approaches, without which the great public benefits which the improvement of the harbour is calculated to confer will be in some measure lost. The position of this harbour is such as shall be afterwards adverted to; that independently of its importance to a large and populous district, it could easily be made a harbour of refuge, where a harbour of this description is most wanted, and might thus be made a national object; and, considering the efforts made by the parties locally interested, and what they have accomplished, the Memorialists venture to entertain the belief that there is a well-founded claim on the Government for encouragement and assistance in their present difficulties.

2. That the Memorialists were incorporated under the Act 2 Victoria, cap. 16. At that time the harbour of Aberbrothwick belonged to the magistrates and town council of the burgh. "The piers, quays, and other works of and within the harbour, had become insufficient for the accommodation of the shipping and trade of the burgh, and they were unfit for the reception of vessels of any considerable size." Application was therefore made to Parliament, and the Act referred to was passed, appointing trustees with power to acquire the right to the harbour from the magistrates and council; to take the administration of the harbour; and to carry out the plan for its extension and improvement. For these purposes the trustees were authorised to borrow and take up at interest, not exceeding the sum of 50,000*l*., on the credit of the harbour, and rates and duties, and other revenue and property of the same.

3. The Memorialists have to the utmost of their power carried into effect the objects of the Act. They have repaired and greatly improved and enlarged the harbour, having constructed a sea wall and a new outer harbour and other works, whereby the accommodation for the shipping and trade of the port has been much more than doubled.

4. In carrying on these works the Memorialists have already expended a larger sum than the whole funds provided are adequate to pay. As before stated the sums authorised to be borrowed under the Act of Parliament are limited to 50,000*l*. Up to this time the Memorialists have expended on the works contracted for and executed by them (including 10,000*l*. paid to the magistrates and town council for the old harbour) not less than from 57,500*l*. to 58,000*l*. A part of this outlay, to the extent of from 4000*l*. to 5000*l*., has been liquidated by means of the surplus revenue for the last few years. But the mortgage debt amounts to 50,000*l*., and there is besides upwards of 8000*l*. which was due to contractors and others, and to meet which no funds existed; and the Memorialists have been relieved from the immediate pressure of this difficulty by means of a temporary advance made to them by the magistrates and town council.

5. The Memorialists have been enabled to do thus much by the cordial encouragement and support they received from the inhabitants of the town and immediate neighbourhood, whose public spirit has been manifested throughout in an extraordinary degree. It has been mentioned that the harbour formerly belonged to the magistrates and town council. Its revenues were then applied to the

APPENDIX C.

ARBROATH.

No. 164.
Memorial of Harbour Trustees to the Tidal Harbours Commissioners.

ordinary purposes of the burgh, and this application of them enabled the magistrates to administer the municipal affairs, and to defray the expense of watching, lighting, paving, &c., without any tax being levied on the burgesses and inhabitants. But so zealous were all parties in the design of extending and improving the harbour (1837 and 1838) that public meetings of the burgesses and inhabitants were held, at which it was unanimously resolved to adopt the provisions of the General Police Act, and so transfer the whole burden of lighting, watching, paving, &c., from the burgh funds to the inhabitants, with the understanding that the administration of the harbour should be vested in parliamentary trustees, and its revenues devoted exclusively to its own purposes. And as the burgh had contracted a considerable sum of debt, chiefly in the repair and improvement of the old harbour, it was agreed that such a moderate compensation as might meet that debt should be given to the magistrates and council for renouncing their right to the harbour and its revenues. Upon this footing, and with the magistrates and council for its promoters, the Act of Parliament under which the memorialists were appointed was obtained. Nor was it only in this instance that local exertions were made and burdens submitted to; for when it became necessary to raise funds on the credit of the harbour and works in order to carry out the intended improvements, those of the inhabitants who could conveniently do so, advanced money on loan to a considerable amount; while many others came forward and gave their personal guarantees for repayment of the advances obtained on a bank credit in name of the memorialists. The amount of the guarantees given by individuals in this way varying in sums from 100*l.* to 1500*l*, was not less than 24,000*l.*, and their obligations are still existing undischarged.

6. After all these exertions, there still remain of the works to be executed the conversion of the inner or old harbour into a wet-dock, and the deeping of the harbour and its entrance and approaches. The former improvement may be deferred for a time at least, but the latter, the deepening of the harbour and its entrance and approaches, has become so pressing and of such vital importance, that the memorialists, under the circumstances in which they are placed, are constrained to take measures for bringing the case under the consideration of the Government, through the intervention of your Honourable Board, in the hope that it may be held to call for and justify the interference and aid of Government as a matter affecting the public interest. The memorialists and the community with which they are connected have done their utmost, and it is only after having entirely exhausted their own resources that they ask for public support.

7. They have no remedy in a renewed application to Parliament for power to raise a further sum of money, because such an application would be unavailing unless the memorialists could show that their revenue would warrant the outlay; and although Parliament were to grant the power, loans could not be effected without adequate security which at present the memorialists have no means of giving.

8. A plan of the harbour as it now stands accompanies this memorial. Previously to the commencement of the recent improvements, the harbour was insufficient in every respect. There was a want of sufficient depth of water, and the quays and wharf walls were in bad order, and the jetty at the entrance was in a state of dilapidation. The want of accommodation, by reason of the smallness of the harbour, was such that it was frequently crowded to excess. At times the ingress was completely stopped up, and the trade of the town at a stand. The larger class of vessels had mostly to winter in other ports. These last-mentioned inconveniences have been in a great measure removed; the improvement effected by the memorialists has for the present provided abundant accommodation within the harbour; but the complaint of want of a sufficient depth of water in the harbour and its entrance and approaches remains in full force, and this want is the more grievously felt, inasmuch as it is a total barrier to the enjoyment of the advantages of the improved harbour. There is only a depth of eleven or twelve feet at the entrance at ordinary spring tides, and only eight or nine feet at ordinary neap tides. Vessels of 150 tons and upwards (of which there are a number belonging to the port) cannot enter or leave the harbour but at the height of the springs, and those of smaller burthen are often detained for several days waiting the tides. The works of the new harbour have been constructed in contemplation of the entrance, &c., being deepened from four to six feet, and were this accomplished, there would be from seventeen to eighteen feet of water at ordinary spring tides, in place of from eleven to twelve feet as at present.

9. The harbour is situated on the German Ocean, and on a rocky and dangerous coast. From the point at the extremity of the Return Head of the new sea wall towards the sea, the ground is quite flat for nearly a quarter of a mile, till it reaches what is termed the *bar*, beyond which the depth of water increases rapidly. This flat ground is quite dry in spring tides, and presents no difficulty to the deepening of the channel. That a safe harbour accessible to vessels of considerable size would at this point be of immense benefit to the extensive and populous district with which it is immediately connected is perfectly obvious, and it is no less certain that it would be an object of national importance. The greater part of the east coast of Scotland is well known as presenting continued ranges of precipitous rocks; and with the wind on a lee shore, this coast is extremely dangerous. The entrance to the Tay is frequently no less hazardous, and the destruction of property and loss of life on the banks of that river have been of late years very great. From the body of fresh water issuing from the Esk and the Dee, and with the wind on the land, it is found difficult to take Montrose or Aberdeen. If, therefore, the projected improvements at Arbroath were completed, its harbour would be a great national benefit as a harbour of refuge to the whole east coast of Scotland.

10. Aberbrothwick, or Arbroath, as it is commonly called, is now a flourishing and populous town, the seat of extensive manufactures, and is daily increasing. In the year 1742, it contained only 2500 inhabitants; it now contains a population of about 15,000.

11. The old harbour was built about the year 1725, and had then belonging to it only a few vessels engaged in the coasting trade. During the year ending in October, 1843, which was one of depression in the trade of the district; the number of vessels reported inwards from foreign ports was eighty-nine, and the total number of vessels that entered the harbour was 749.

	£.	*s.*	*d.*
In 1727, the shore dues of the port amounted to . . .	25	1	8
In 1746, they were only	20	16	8
In 1793, they were	293	0	0
In 1803, they were	370	0	0
In 1813, they were	731	0	0
In 1823, they were	615	15	0
In 1833, they were	1312	0	0
In 1843, they were	3050	0	0

APPENDIX C.

ARBROATH.

No. 164.
Memorial of Harbour Trustees to the Tidal Harbours Commissioners.

Further statistical details will be found in the accompanying documents; viz.,

1. Abstract of shore dues of the harbour of Aberbrothwick, annually, from 1727 downwards.
2. Printed copy, memorial, and petition. Petition by the magistrates and others to the Lords of the Treasury for having Arbroath declared a free port, 1844.
3. Abstract of the harbour accounts for the year 1840.
4. Ditto ditto 1841.
5. Ditto ditto 1842.
6. Ditto ditto 1843.

11. Your memorialists respectfully submit the above statement to your Honourable Board, with the view of its being made the means of drawing the attention of Government to the circumstances. The case is peculiar and cannot be considered as falling under a class. The resources of the locality have been exerted and strained to the utmost for the attainment of an object which is undoubtedly of a public nature. That object is nearly accomplished; 58,000*l.* had been raised and expended in making an important harbour, with deep foundations, on a coast where it greatly concerns the public interest that there should be such a harbour. But there is an absolute want of means to deepen this harbour and its entrance, so as to render what has been done available, and it is for that purpose that the present appeal is made. The memorialists have procured an estimate of the expense of executing this work to the extent of gaining three feet of additional depth of water, and the amount is only 9000*l.* In this emergency the memorialists humbly trust that, through the recommendation of your Honourable Board, Government may see cause to interfere, and make a grant of public money for a public purpose so highly desirable, and under circumstances which urgently call for and justify it.

Signed on our behalf and by our appointment, by

W. F. LINDSAY CARNEGIE.*
JOHN MACDONALD.

No. 165.

No. 165.
Leslie's Estimate for Deepening the Dock.

Estimate of the probable Expense of Deepening the Old Harbour of Arbroath two feet, and the New Harbour, with the entrance thereto, three feet, each division being excavated on an average to these depths, although some parts may require more and others less excavation to give a fair and uniform bottom, sloping regularly outwards to the deep water.

	£.	s.	d.
Old Harbour, 5600 cubic yards, at 1*s.* 3*d.*	350	0	0
New Inner Harbour, 13,654 cubic yards, at 1*s.* 6*d.*	1024	1	0
Outer Harbour, as far as the old breakwater, 4451 cubic yards, at 2*s*	445	2	0
Channel out to the outer heads (chiefly rock), 4155 cubic yards, at 2*s.* 6*d.*	623	5	0
Fairway, beyond outer heads, widening out to 600 feet at the outer edge of the bar (rock and boulders), 28,666 cubic yards, at 4*s.*	5733	4	0
	8173	12	0
Contingencies, 10 per cent.	817	11	0
	£8993	3	0

Say £9000.

JAMES LESLIE.

London, April 29, 1845.

No. 166.

No. 166.
Second Memorial of Harbour Trustees to Tidal Harbours Commissioners.

The Memorial of the Trustees of Aberbrothwick Harbour to the Tidal Harbours Commissioners.

September, 1845.

A SHORT time ago the memorialists submitted to your Honourable Board a statement of circumstances connected with Aberbrothwick Harbour, in support of an application made by them for aid from Government to enable them to deepen the harbour and its entrance. This application was favourably entertained and reported on, but has not yet been disposed of.

An occurrence took place lately, which strongly supports the memorialists' claim for Government assistance, and the memorialists beg most respectfully to bring it under your notice:—

On Tuesday, the 19th of August last, a strong gale from the north-east, with heavy sea, prevailed along the whole east coast, and it increased so much that night and the following day, that a fleet of herring boats, in the Moray Firth, were driven to seek shelter and safety in the nearest harbour. They were unable to take Peterhead; they then tried to take Aberdeen, but failed; the first boat that attempted it being wrecked. They were equally unsuccessful at Stonehaven, and at Montrose, and they were driven onward for Arbroath. The whole coast near to Arbroath seemed covered with them, and as the sea was running very high, and the gale unabated, there was great excitement in the town, and much fear entertained of a disastrous result. Several of the boats were near enough the shore to make it apparent that the crews were almost exhausted, and in extreme distress, and the life-boat was got in readiness, and other measures adopted in case of the worst. Providentially the whole of the boats, twenty-two in number, took the harbour in perfect safety.

There were five other vessels in sight at the time, two of them foreigners, which seemed determined to run for Arbroath Harbour, but there was not sufficient depth of water, and they were warned off by signals from the shore.

The memorialists are well warranted in stating that had the harbour and entrance been deepened as proposed, these vessels might, without difficulty, have obtained shelter in the same way as the herring boats did, and the risk they encountered by being compelled to remain at sea during the storm would have been saved.

The case of Aberbrothwick Harbour is now most urgent. The memorialists are confident that there are abundant public grounds to justify the Government in granting the aid applied for, and they venture to solicit your Honourable Board to give the application such further support as may appear to you proper.

Signed in our name, and by our appointment, by } JAMES GIBSON, *Chairman.*

No. 167.
Letter from Wm. Leask to the Harbour Trustees.

No. 167.

Letter from WILLIAM LEASK, *Master of the Barque "Hants," of Aberdeen, to Messrs. Louson and Macdonald, clerks to the Aberbrothwick Harbour Trustees.*

GENTLEMEN,

Arbroath, September 29, 1845.

I THINK my case so hard that I cannot help making a complaint to you, to be laid before the Arbroath Harbour Board.

I arrived off Arbroath with my barque, the "Hants," of Aberdeen, burthen 230 tons, having a cargo of wood from St. John's, on the 19th current: I expected to get into the harbour, and attempted it, but failed, there being an insufficient depth of water, though to a small extent, which was the more annoying. I tried to lighten my vessel, but I could not succeed, owing to the roughness of the sea. I was obliged at last to run into the Tay, and lighten her there, and it was only this day that I got her into your harbour. This has been attended with great expense and heavy loss to me. My costs out of pocket I estimate at not less than 80*l*., being part owner of both ship and cargo.

I think under these circumstances that some consideration ought to be given to my case. The neglect or delay to deepen the harbour and the entrance to it is the sole cause, and there ought to be redress given.

I am, &c.,
WILLIAM LEASK.

No. 168.
Statement of Shipwrecks in the vicinity of Arbroath, 1796 to 1845.

No. 168.

Statement of Shipwrecks in the vicinity of Arbroath, 1796 to 1845.

Arbroath, May 29, 1845.

MEMORANDUM of meeting with Messrs. David Muir, William Cargill, William Chapel, and George Kidd, all shipowners in Arbroath; also Mr. Alexander Livie, formerly shipowner.

The above-named gentlemen recollect distinctly of the following cases of shipwreck :—

1796.—*Charlotte*, lost to the westward of Arbroath; was taking the harbour, but in consequence of the insufficiency of water in harbour entrance, was wrecked. Two lives lost.

1800.—On 1st January. Great many vessels off the harbour; could not get in from want of water; a foot additional water would have allowed them to come in. While waiting till the tides should increase, a storm came on, and they were driven off land; two Arbroath vessels lost, the *John* off Bervie, and the *Betsy and Susan* at Elliot, about two miles to the westward of Arbroath; other two got into the Tay by the merest chance. Two or three Aberdeen vessels were wrecked at the Currends, a ledge of rocks some miles to the westward of Arbroath; and the *Swallow* of Aberdeen was lost about a mile to the eastward. The whole coast from the Redhead to Barry was strewed with wrecks. Had there been a harbour of refuge at Arbroath, or even had there been a sufficiency of water in the entrances, the vessels wrecked and lost on this occasion might have been all saved.

1803.—*Hamburgh Packet*, of London, went ashore at East Haven; not sufficient water for her in entrances to harbour; was driven on by a gale of wind; crew saved. *London Barque* got on the coast and attempted to take the harbour, but from want of water could not get in; she was afterwards lost at Aberdeen. *Henrietta*, a Prussian barque, wrecked between East and West Haven.

1804.—*John*, of Sunderland, went ashore at Links Toll, about a mile to the westward of Arbroath; when she was making for the harbour; cause, want of water; crew saved.

1806.—*Fortitude*, of Arbroath, wrecked in coming into harbour; same cause.

1809.—*Sunderland Sloop*, with lime, went ashore at Elliot; two of the crew lost.

1818.—*Elrigg*, from St. Peterburgh, stranded near Arbroath.

1828.—*Clyde Packet*, bound for Aberdeen; storm came on very suddenly when off Arbroath harbour. She bore down for it, but, in consequence of the insufficiency of water, she was wrecked to the westward, opposite the Ropework; crew and passengers all saved, with the exception of a child; several had broken legs, arms, &c.

1829.—*Wasp*, of Arbroath, wrecked at back of old pier, near lighthouse; cause, want of sufficient water.

1834.—*Industry*, from Alloa to Dundee, wrecked near Arbroath.

1839.—*Lord Kinnaird*, went ashore at east entrance of harbour, in consequence of there not being sufficient depth of water.

1842.—*Acorn*, of Arbroath, went ashore close off the harbour; cause—want of sufficient depth of water.

1843.—*Ann*, of Arbroath, ditto, ditto. *Louisa*, of Arbroath, lost off Arbroath from the same cause.

1844.—*Union*, or Alloa; struck at the bar, and was afterwards driven on Protection wall; 12 inches more water would have saved her; vessel much damaged. *Defiance*, of London, wrecked to the westward of Arbroath, in consequence of want of sufficient depth of water.

1845.—*St. Andrew*, of Arbroath; off Arbroath harbour for about a day waiting rise of tides; in consequence of a gale of wind which came on suddenly, she sailed round to Montrose, but in taking Montrose harbour she struck on the Annat rock, and became a total wreck.

It frequently happens in the winter season, say three or four times a week, and sometimes with about a dozen ships, that when driven out of the Forth or the Tay by westerly gales (which they often are without anchors, and with sails much damaged), they try to take Arbroath harbour, but in consequence of the insufficient depth of water that is found impracticable, that is, with ships which draw more than 12 feet of water; vessels of less draft often get shelter. There is no other harbour that vessels can take with a gale of westerly wind along the whole coast.

There never was a ship, in the recollection of any of the above gentlemen, that could not take Arbroath harbour in any state of weather, provided there were depth enough of water, and they never saw a vessel attempt to take the harbour but succeeded when there was sufficient water.

Vessels have been frequently, and still are, dragged into the harbour from the bar by means of ropes owing to the want of water.

The gentlemen above named are satisfied there have been more cases of shipwreck on the coast than those above mentioned, but they do not recollect them particularly at present. There has been no record

No. 168.
Statement of Shipwrecks in the vicinity of Arbroath, 1796 to 1845.

kept of the vessels wrecked. Many vessels that have passed Arbroath, and would have entered the harbour had there been a sufficient depth of water, have never afterwards been heard of.

What is contained in this statement we certify to be facts known to us, and to the accuracy of which we have no hesitation to make oath if found to be necessary.

DAVID MUIR.
WILLIAM CARGILL.
WILLIAM CHAPEL.
ALEXANDER LIVIE.
GEORGE KIDD.

Mr. Chapel mentioned a case as proving that Arbroath would be a suitable place for a harbour of refuge. A French steamer on her way to Dundee, to get in her machinery, could not get up the Tay in consequence of westerly gales; she came into Arbroath harbour, where she lay till the wind changed, and she then took the Tay. This occurred about five years ago.

JOHN NAIRN, pilot, corroborates all the preceding statements; recollects the *James*, of Arbroath, going ashore at East Haven; she was from Norway, with timber; heavy gale of wind and thick weather. Recollects of the storm on 1st January, 1800, when so many vessels were lost off the coast, as already detailed. *Cato* went ashore about 10 or 12 years ago, to the eastward of the harbour, when bound for the Baltic; came too close in land; wind off shore. About 1790, a Perth sloop went ashore betwixt Arbroath and the Cliffs. Recollects being pilot on board a Perth brig bound for Arbroath; she drew a foot water more than there was in entrances to harbour. The captain insisted on taking the vessel in, and the consequence was that when close in shore she struck and was wrecked at the back of the battery, and was considerably damaged; thinks this was about twenty years ago.

JOHN NAIRN.

No. 169.

No. 169.
Statement of Dues, 1727 to 1845.

Statement of the Shore Dues from 1727 *to* 1845 *inclusive.*

Year.	Amount Sterling.			Year.	Amount Sterling.			Year.	Amount Sterling.			Year.	Amount Sterling.		
	£.	s.	d.		£.	s.	d.		£.	s.	d.		£.	s.	d.
1727	25	1	8	1757	85	0	0	1787	300	0	0	1817	649	0	0
1728	25	1	8	1758	89	16	8	1788	300	0	0	1818	681	0	0
1729	25	0	0	1759	92	10	0	1789	300	5	0	1819	692	0	0
1730	26	14	2	1760	95	15	0	1790	310	5	0	1820	772	0	0
1731	28	16	8	1761	114	0	0	1791	315	10	0	1821	710	0	0
1732	30	0	0	1762	133	5	0	1792	270	0	0	1822	1,056	5	0
1733	27	10	0	1763	141	0	0	1793	293	0	0	1823	615	15	0
1734	27	1	8	1764	160	0	0	1794	270	0	0	1824	1,021	0	0
1735	25	8	4	1765	165	0	0	1795	370	5	0	1825	1,316	0	0
1736	27	18	4	1766	200	0	0	1796	376	10	0	1826	1,100	0	0
1737	33	10	0	1767	246	0	0	1797	451	0	0	1827	1,050	0	0
1738	31	0	0	1768	245	0	0	1798	420	10	0	1828	1,430	0	0
1739	36	13	4	1769	268	6	10	1799	420	0	0	1829	1,425	0	0
1740	25	8	4	1770	252	14	0	1800	442	0	0	1830	1,431	0	0
1741	26	13	4	1771	240	5	0	1801	460	0	0	1831	1,300	0	0
1742	26	13	4	1772	260	9	8	1802	350	0	0	1832	1,301	0	0
1743	29	13	4	1773	245	0	0	1803	370	0	0	1833	1,312	0	0
1744	Not known.			1774	230	0	0	1804	431	0	0	1834	1,200	0	0
1745	21	8	4	1775	271	2	8	1805	460	0	0	1835	1,200	0	0
1746	20	16	8	1776	285	14	7	1806	640	0	0	1836	Not known.		
1747	21	0	0	1777	290	0	0	1807	601	0	0	1837	Ditto.		
1748	24	1	8	1778	269	8	2½	1808	735	0	0	1838	Ditto.		
1749	23	13	4	1779	256	0	0	1809	622	0	0	1839	Ditto.		
1750	33	6	8	1780	251	0	0	1810	702	0	0	1840	Not obtained.		
1751	34	13	4	1781	257	0	0	1811	745	0	0	1841	3,346	13	8
1752	31	13	4	1782	247	0	0	1812	691	0	0	1842	2,858	19	10
1753	70	8	4	1783	250	0	0	1813	731	0	0	1843	3,050	15	0
1754	75	0	0	1784	250	5	0	1814	701	0	0	1844	2,889	18	1
1755	92	3	4	1785	255	0	0	1815	690	0	0	1845	3,271	18	5
1756	82	0	0	1786	288	0	0	1816	750	0	0				

* For the four years subsequent to 1835 the harbour was managed under an arrangement with a view to the change which was afterwards sanctioned by Parliament.

APPENDIX C.

ARBROATH.

No. 170.
Comparative Statement of Revenue, 1845-6.

No. 170.

Comparative Statement of Revenue at the Harbour of Arbroath, from 15th *October to* 15th *September*, 1845 and 1846.

	1845			1846			Increase.			Decrease.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
Imports	2242	11	10	1690	2	1		..		552	9	9
Exports	525	8	7	471	0	6		..		54	8	1
Lights	47	19	10	41	6	10		..		6	13	0
Patent slip	131	18	9	166	3	5	34	4	8		..	
Pilot master's fees .	44	1	6	37	8	3		..		6	13	3
Ballast sold . . .	11	16	0	23	9	4	11	13	4		..	
Repairing bank . .		..		0	5	0	0	5	0		..	
Harbour ropes . .	0	16	0	0	11	0		..		0	5	0
										620	9	1
Total	3004	12	6	2430	6	5	46	3	0			
										574	6	1

Shore Dues Office,
Arbroath, September 30, 1846.

DAVID KEY, *Collector.*

No. 171.
Income and Expenditure.

No. 171.

Return of Income and Expenditure for the Years 1841-2-3.

INCOME.

Heads of Income.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Import dues . .	2571	3	4	2103	10	3½	2349	9	9
Export dues . .	557	9	6	563	2	7	487	2	2
Sundries . . .	218	0	10	192	6	11½	214	3	1
Total . . £	3346	13	8	2858	19	10	3050	15	0

EXPENDITURE.

Heads of Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Salaries . . .	365	5	0	309	0	0	309	0	0
Repairs . . .	771	15	4	490	15	7	202	5	0
Incidental charges	95	7	2	122	6	11	95	13	5
Rent	7	10	0	7	10	0	10	8	4
Interest . . .	634	1	1	1276	13	5	1938	6	2
Total . . £	1873	18	7	2206	5	11	2555	12	11

The dues are levied under Act 2 Vict., c. 16.
Debt due on the 1st January, 1846, 53,514*l.*

F. MARTIN, *Collector.*
ADAM STEVENSON, *Comptroller.*

MONTROSE.

APPENDIX C.

MONTROSE.

No. 172.
Evidence taken on the 29th Sept., 1846.

No. 172.

Examining Commissioners—Captain WASHINGTON, R.N., assisted by Captain VETCH, R.E., F.R.S., Admiralty Engineer.

Present:—WILLIAM JAMESON, Esq., Chief Magistrate; Messrs. DAVID BIRNIE, DAVID HILL, GEORGE SMART, WILLIAM SHANN, BAILIE MACKIE, CHRISTIAN H. MILLER, CHARLES BIRNIE, JAMES BROWN, Harbour Trustees; Captain JAMES BENNETT, R.N.; Mr. A. BURNES, the Secretary; Mr. SMITH, Collector of Dues; Mr. J. BURN, Berth-master; various Members of the Town Council; Messrs. ALEXANDER BRAND, DAVID ROBERTS, and other Shipmasters; JOHN ABERDEEN, Esq., Mr. WILLIAM HODGE, Mr. DAVID SMITH, and other Shipowners.

[*Plans of the harbour and basin by Mr. Leslie, C.E., made in* 1837, *and the Admiralty plans of the harbour and adjoining coast, made by Captain Slater, R.N., and his assistants, in* 1833, *were laid on the table.*]

The COMMISSIONERS having read the Royal Commission, which authorised the holding of the meeting, stated that this was an inquiry into the past and present state of the harbour of Montrose, and its capabilities for further improvement. They had that day, in company with the harbour master, visited and inspected the harbour, the quays, and the floating dock. On a former occasion, in the autumn of 1844, Captain Washington, in company with some of the harbour trustees, had visited and inspected the embankments on the South Esk, near Old Montrose; it only remained therefore to take the evidence of the officers of the trust, and afterwards they would be ready to hear the remarks, opinions, or suggestions of any person, whether trustee, merchant, mariner, or pilot, or in fact of any one interested in the welfare of the port.

Mr. Adam BURNES examined—Is a solicitor, and clerk to the Montrose Harbour Trust since 1837. The harbour is governed under an Act of the 1 Vic., c. 99, which appoints twenty-two persons, including eight merchants or shipowners of Montrose, as trustees. The Act gives power to raise 40,000*l.*, the whole of which has been borrowed and, with the addition of 5,000*l.*, expended upon making a wet dock and other improvements. Prior to obtaining the Act the harbour was governed by the town council of the burgh under charter of King David II., which gave authority to levy shore dues, in virtue of which the quays had been built, and other works done to the harbour. The immediate cause of going to the great expense of building a wet dock was in consequence of damage received by sharp vessels lying alongside the quays, and that the quays in their present state would not admit of being dredged sufficiently deep to keep such vessels afloat; a wet dock, therefore, of 3¼ acres area was designed by and carried out under the superintendence of Mr. James Leslie, of Dundee, C.E. The entrance is 55 feet wide; it has 19¼ feet water over the sill of the dock gates at spring tides, and 16 at neaps; and has fully answered expectation, the revenue of the port having considerably increased, and vessels lying in much greater security. Had it been thought desirable, the quays might have been rebuilt on deep foundations, probably for 25,000*l.* The river, owing to the wide expanse of the Slake or basin, is not subject to freshes of any importance, but at all times, except at slack water, there is a rapid current, running in or out of the harbour, as the basin fills or empties. Is of opinion that the Annat Bank on the north side of the entrance has a tendency to rise, which is counteracted by the scour from the Slake. The two lighthouses exhibiting leading lights were built at the expense of the merchants, in 1817. There is a life-boat in good order, maintained by private contribution. Also an abundant supply of provisions, as well as coal, masts, and stores, and water led down to the quays; there is a patent slip proved for 400 tons, and about 100 men employed shipbuilding. The accounts are annually audited by an auditor who is not one of the trustees, and published. The rate of interest for the debt is 4½ per cent. The cost of obtaining the Act was 2,500*l.*, owing to its being opposed, chiefly on account of the increased dues; but even now they are 20 per cent. less than at Dundee. Produced the minute-book, letter-book, and account-book of the trust.

The COMMISSIONERS said that as far as cursory inspection would enable them to judge, the books appeared to be in good order and carefully kept.

Mr. BURNES.—With respect to the suit pending between the Montrose trustees and Sir James Carnegie, relative to encroachments on the banks of the South Esk, near Old Montrose, no further steps have been taken since witness laid the whole case before the Admiralty, in 1842, and the Tidal Harbours Commission in 1845; the simple facts of the case are as follows:—in 1841, Mr. Leslie, C.E., was consulted by Sir James Carnegie about the best mode of protecting his land from being encroached upon by the river South Esk, who recommended that he should direct the channel of the river a little; to this the trustees made no objection, and it was done; but in the following year Sir James ran an embankment out from the Old Pier, and enclosed 65 acres of the bed of the basin over which the water rose four feet at every spring tide. In June, 1842, witness on the part of the trustees, remonstrated by letter against this proceeding, and in person intimated a protest against it. He also memorialized the Admiralty, and Mr. Rendel, C.E., was ordered to inspect and report on the works. Having recently completed a wet dock and other works at Montrose, at a cost of 42,000*l.*, the trustees had expended all their funds, which alone prevented their instituting legal proceedings; they therefore applied to the Admiralty to help them in the preservation of a public harbour from encroachments by a neighbouring landed proprietor. Mr. Rendel reported that the complaint was well founded, that 12,000,000 cubic feet of water had been excluded on every spring tide, and recommended that the channel should be deepened in order to afford compensation for the water excluded. This was not complied with by Sir James, and the whole case was referred to the Lord Advocate for his decision. Is not aware that any legal opinion in the case has since been given.

Three other encroachments had been made by the predecessors of Sir James Carnegie, or by himself—one in 1817, another in 1830, and a third in 1831. The exact extent of acreage cannot state from recollection, but it appears from the plans that two of them were of 30 acres each. Cannot understand why the Board of Woods and Forests, that has claimed the alveus of the Clyde on the part of the Crown, does not take up the case and insist on the restitution of the ground in question, or of compensation being made.

The COMMISSIONERS said there could not be a doubt as to the prejudicial effects of such enclosures, nor to their illegality. All engineers who have examined them, and some of the most eminent in the kingdom have done so, are agreed as to the damage they are likely to cause to the harbour. As to the legal doctrine that it is understood has been propounded, that it is necessary to wait and see the damage caused before taking any steps to prevent it, it is utterly unintelligible; or it such doctrine is to be admitted as law, there is at once an end to all conservancy of the harbours of the United Kingdom.

MR. JOHN SMITH, collector of harbour dues, stated that the arrivals during the year 1845 had been 934 vessels of 62,677 tons; of this the coasting tonnage was 52,952, the foreign 9,725. The vessels belonging to the port were 108 of 14,000 tons.

Abstract of the number of arrivals and tonnage, together with the amount collected from the harbour and light dues respectively, from 1840 to 1846, the year ending on the 31st May:—

Years.	Arrivals.	Tonnage.	Harbour Dues.	Light Dues at ½d. per Ton.
			£. s. d.	£. s. d.
1840	955	66,778	3243 3 8	139 2 5
1841	983	64,691	3266 13 3	134 15 5
1842	1010	68,036	3285 15 3	141 16 11
1843	1018	67,889	3252 10 8	141 8 8
1844	908	61,717	3031 9 1	128 11 6
1845	921	64,364	3332 17 9	134 1 10
1846	934	62,677	3276 7 1	130 11 6½

The custom dues for 1845 amount to 25,633*l*. The population of Montrose is 16,000, but the port supplies a district of from 75,000 to 100,000 of population.

CAPTAIN ROBERTS is of opinion that the "Leads," a cluster of rocks lying about 200 yards off the Ness, are a great evil to the harbour, and cause much risk to vessels in taking it. Damage occasionally arises from the freshes, when heavy, and also from the swell and range in the harbour, at high water, in heavy easterly gales. Thinks the sleke has rather deepened since the removal of the old bridge. A vessel of 500 tons can come up as high as the bridge; there is accommodation in the harbour for four times the present traffic.

MR. D. BIANIE thinks the "Leads" are a protection to the harbour, and help to break the swell in south-easterly gales; but the Cross Dykes, a ridge across the river a little below the lower lighthouse, should be dredged or blasted away; the channel from this spot to the "Stell" also requires to be dredged. All agree that the "Stone," a rock running out directly from the Ness, should be removed, as it tends considerably to narrow the entrance of the harbour. The shingle bank, called the Scalp, also should if possible be removed, or at any rate steps be taken to prevent its encroaching on the north side of the river, and with this view it might be an advantage, if the arch in the bridge on the south side should be shut up. The Bridge Act was obtained in 1825, and the old wooden bridge pulled down, and the present suspension bridge erected by Captain Sir Samuel Brown, in 1829. Owing to the greater freedom of the scour since the removal of the old bridge, the water in the upper part of the harbour has materially deepened. There are 16 feet at this bridge. The quays are far from being in a good state of repair; they require to be clamped. Has known a vessel break her back lying aground alongside the quays, but now there is not half the damage that occurred formerly. A ship of 440 tons, and drawing 17 feet of water, has been in the dock. There is a depth of 18 feet at the entrance of the river at low water, and 8 feet at the Cross Dykes, and the harbour may be run for at all times, as the leading lights kept in one lead into safety. The chief wrecks take place on the Annat Bank, but it would be difficult to find any remedy for that sand. It would be a great boon if Government would lend money, say 40,000*l*., to the harbour at a low rate of interest instead of being compelled to pay four and a half and five per cent. as at present; by such means they would be enabled to carry out the improvements that had been suggested, which would confer a public as well as a private benefit.

MR. JAMES BURN has been harbour master for seven years, and acquainted with the harbour for thirty-seven years. Is of opinion that the dock is a very great benefit to the shipping interest; the entrance to it is 55 feet wide, but it would be easier to get vessels in and out if it opened into a tidal basin; the *Victor* had received some damage in consequence; the entrance gates would admit the largest war-steamers in width, and, with the exception of Dundee, there is no similar dock in Scotland; the dock quays afford 1500 feet of wharfage, the main quays about 1700 feet. The rise of tides on springs is 14 feet, at extreme tides 16 feet; and neaps rise to 11 feet above datum or low-water of spring tides. Owing to the dock wall projecting into the river there is a better scour than there was formerly; the tide stream runs five knots in and out of the harbour. Is of opinion that the Scalp might be removed with advantage. There is a patent slip for vessels of 400 tons register, which is found to be a great accommodation, but there is no graving dock. Witness is pilot master; there are 20 pilots; they pass an examination before the harbour trustees and himself, and receive a licence and a badge; they have only open boats in which to go out and look for ships; the rates of pilotage and bye-laws are publicly exhibited on the quays; there are no complaints against the pilots; they are paid by the job and not by salary.

MR. SMART is not of opinion with former witnesses as to the great benefit to the trade of the wet dock; thinks that the improvement most wanted is a dredging-machine to deepen the river, and especially to remove the Cross Dykes and other obstructions; a tug-steamer is also much needed for the traffic of the port.

The COMMISSIONERS having invited any further remarks or suggestions, said that they could not close the proceedings without expressing their high opinion of the public spirit and proper conduct evinced by the trustees in having resisted so decidedly the encroachments made upon the rights and boundaries of their harbour upon the banks of the South Esk, near Old Montrose, and they trusted that they would continue to do so in the event of a similar attempt, being well assured that ultimately right must and will prevail over might.

(*Adjourned.*)

No. 173.

No. 173. Returns of Acts, Plans, &c.

Return to Order of the House of Commons of the 9th August, 1844.

Montrose, April 12, 1845.

SIR,

I HAVE the honour to transmit you herewith, in terms of your letter of 1st February last, a return by the trustees of the harbour of Montrose, stating the titles of the several Acts of Parliament under which they have acted and now act; also copies of the following documents:—1 Vic. cap. 99, An Act for improving the harbour of the Burgh of Montrose, in the county of Forfar, 3rd July, 1837.

1. Map or plan of the harbour and basin of Montrose, by James Leslie, Esq., C. E. (1837), with additions in red ink, showing the recent embankment by Sir James Carnegie, referred to in No. 3, infra.
2. Report by James Walker, Esq., C. E., dated 18th January, 1839.
3. Report by James M. Rendel, Esq., civil engineer, dated 24th November, 1842.

It is proper to mention that the original of Mr. Walker's Report is now in the hands of the Exchequer Bill Loan Commissioners, and that I have no copy of the sketch of the wet dock annexed and referred to in it.

I am, &c.,
ADAM BURNES, *Clerk*.

To the Honourable H. Manners Sutton, &c. &c.
Whitehall, London.

No. 174.

No. 174. Walker, on the proposed Wet Docks.

Report of JAMES WALKER, Esq., C.E., F.R.S., *on the proposed Wet Docks at Montrose.*

January 18, 1839.

THE instructions of the trustees of Montrose Harbour communicated to me by you, are, that the plans of the proposed wet docks, prepared by Mr. James Leslie, be submitted to my consideration.

With the examples before you, it would be little better than a waste of your time, if I were to occupy it by any argument in favour of wet docks; I am not asked to do so, and there is probably no member of your Trust who is not aware of their importance, particularly when the present build of ships, and the accommodation given by docks in the other principal ports, are considered. I shall, therefore, at once proceed to the matter referred to me.

Having visited Montrose in company with Mr. Leslie, early in December last, I surveyed the sites and plans of docks proposed by that engineer, viz.:—the Howloge-hill site, and the other between Meridan-place and the patent slip, or farther down the river than the Howloge-hill, and I have no hesitation in preferring the lower situation. It places the entrance in a wider and better part of the river, where the eddy tide will render the entering of ships very easy; it interferes less with the present wharfage, and (which I think very important) gives the opportunity of extending the docks, as occasion may require, upon the Links, a property which is uncovered, and belongs to the town.

I consider this site also, whether as respects approach from sea, entrance to the dock, or the dock itself, peculiarly eligible.

First, as to the approach from sea:—

Having had reference to an apparently very accurate survey, by Mr. Buchanan, of Edinburgh, and having been favoured by Captain Beaufort with the Admiralty survey of the harbour, a copy of which is now before me, I find the depth between the Annat Sand and the Leads, at low water of spring tides, from seventeen to eighteen feet, which was confirmed by the soundings I took; outside of this, to deep water, there is nothing less than fifteen feet; inwards the depth decreases gradually to less than half the above,* until opposite the Low Light, when it again increases to 13, 12, 14, 16, 10, and 11 feet, which last is in the Stael, opposite to, and not far from, the entrance to the proposed lower dock. Four feet may be added to all the above depths for the low water of neap tides, thirteen feet for the high water of neap tides, and eighteen feet for the high water of spring tides.

The length from the entrance to the harbour to that proposed for the dock is upwards of a mile, nearly straight, with rocky ground on the south bank, and sand on the north, but no rocks in the channel of the river, the bearing being N.W. by W. ¼ W., and the width in the Stael, opposite to the proposed entrance to the dock, about 300 yards. In this place the direction of the flood tide is thrown over towards the south side, so that for a width of about 100 yards from the shore, there is scarcely any current

The passage from the sea, therefore, up to the dock entrance, may be pronounced decidedly good.

Secondly, as to the entrance:—

Mr. Leslie has pointed the entrance down the river, which, had there been any current to interfere with ships entering, would have been objectionable, but in the present case it is, for the reasons above stated, a matter of comparative indifference.

This entrance is proposed to be fifty-five feet in width, and fifteen feet six inches in depth at the high water of neap tides, which I think sufficient, and was so considered by the trustees when the subject was mentioned at the meeting

Mr. Leslie proposes one pair of gates at first, and shows, by dotted lines upon the general plan, how this extension may be made at any future period into the river, so as to form the entrance into a lock with two pairs of gates. This is the part of the design, the idea of which, for the reason I shall presently state, ought I think to be abandoned.

The dock is to be of the same depth as the entrance, the form a rectangular parallelogram, 450 feet long, and 300 feet broad, giving an area of three acres, which, for a dock, I consider decidedly too small, and that the plan would, therefore, be objectionable, were it not for the great facility of extension upon the Links; my opinion being that, in a very few years, the three acre dock will not be too large for a tide basin with one pair of gates into the river, to be opened before high water, and that then the lock with the double gates should be at the upper end of the basin, to lock out of it up to the inner dock or docks, properly so called, which may then be of the size thought expedient; for what would in respect of size be considered extravagant if recommended now, will not probably appear so when the first dock, which will afterwards be the basin, shall be found insufficient.

The sketch which accompanies this report will better explain my meaning. I would not recommend

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* The Admiralty Survey makes six feet only upon the Cross Dykes, the shoalest place, which must be a very low tide.

APPENDIX C.

MONTROSE.

No. 174.
Walker, on the proposed Wet Docks.

more being done at first towards the ulterior plan, than simply returning the wing walls to form the future entrance, and making the front of the dock or basin wall between these returns of timber piles or baulks to form a dam for future works within, and to be removed when these works shall be completed.

With the above modifications I entirely approve of Mr. Leslie's plan, the execution of which does not appear to me to present any particular difficulty which Mr. Leslie has not provided for.

What was said to me of the apprehension that there would be great difficulty in keeping the works clear of water, led me to inquire particularly respecting the wells that had been dug in the neighbourhood, and the nature of the strata. On these points I had information also from Charles Gordon, an experienced well-digger, as well as from Mr. Leslie and other gentlemen.

There will be water undoubtedly, as the ground is sand and gravel, with silt below; this will have to be pumped out, and the springs and wells round will be drained, but after this is done the water will diminish, and the quicksand lose its quickness. I feel assured, from experience in similar cases, that a moderate-sized pumping engine would overcome the difficulty of water; the docks in the Thames are made in sand and gravel, under a clay surface: the Hull docks are all in silt.

Mr. Leslie having furnished me with a copy of his working plans, I have examined the same, and find that great pains have been taken with them: they are very particular and explanatory. I have also examined the estimate in detail, by taking out the quantities from the plans, and find that the same care has been taken to this. The sufficiency of the prices in some cases, particularly the masonry, may be tested by those who have local information. From the proximity to quarries I think them sufficient, but that the prices of the dams and excavation are close, considering the contingencies to which these works are liable. On the whole I would recommend an addition of £3,000 to the amount of £35,121 upon the works detailed in the estimate. On examining the detail I do not find the following particulars to be included, viz.:—

The dock gates.
Mooring and warping buoys in the river.
Moorings or bollards, in dock.
Pumping (with the steam engine) while the works are in progress.

These will amount to 4,000*l*., making an addition of 7,000*l*. to the estimate of 35,121*l*.

The harbour is intimately connected with the docks, and as my attention was called, and several questions asked at your meeting on the various points relative to the former, it cannot be considered irrelevant if I repeat what I then stated.

I have already referred to the principal features of the entrance and the river up to the Stael. The harbour is considered by you, and probably with reason, as the best between the Forth and Moray Firth; it is, therefore, very important in a public view, although certainly not a perfect harbour of refuge, for with north-east winds the Lead Stone and other rocks are upon the lee, close to the entrance, and nearly dry at low water; and with south-east gales, ships are stated to lie uneasy even in the Stael, yet with westerly, which are the prevailing winds, the harbour affords good refuge. The number of wind-bound vessels that entered into the harbour last year, was sixty-four, and it was stated to me, that twenty to thirty were in the harbour at the same time. Considering the harbour even thus, in a public light, a good beacon should be placed at the entrance, upon the dangerous rock to which I have before alluded; and judging from my experience in this quarter, I think it more than probable, that if a proper representation were made to the Commissioners of Northern Lights, they would either undertake the work, or assist in it.

As the harbour of Montrose may be considered the passage through which the sea water finds it way into the basin, when the tide is at flood, and out of it when the tide is at ebb; and as its depth and width are proportioned to the quantity of water that passes, so everything that diminishes that quantity, or lessens the basin, has the direct effect of lessening the width or depth of the harbour. Therefore, the basin, to the extent that is covered by a spring tide, should be watched with jealousy, and every encroachment prevented. In the Admiralty survey it is included as part of the harbour; it is part of the plan now before me, and every encroachment upon it may, by a special Act of Parliament, be the subject of prosecution; but your interests are more immediately concerned, and you have a better opportunity of guarding this, which may be considered the "lungs" of your harbour.

I am, &c.,
JAMES WALKER.

No. 175.
Answers to Mr. Rendel's Queries, relative to the Basin and Harbour and Embankments.

No. 175.

Answers to Mr. Rendel's Queries relative to the Basin and Harbour Channel of Montrose, and to Sir James Carnegie's embanked Ground, near Old Montrose.

September 16, 1842.

	A.	R.	P.	Y.	A.	R.	P.	Y.
1. Area of the embanked portion of the estuary, south side of river	62	2	30	26				
Ditto north side of river	3	1	30	12				
Total					66	0	21	8
2. Area of the new channel, or portion of land converted into a new channel for the river.								
The whole of the new channel appears to have been covered by high water, and therefore, properly speaking, no portion of land has been converted into the new channel, but the whole area of the new channel, from the upper end of the new embankment to Old Montrose, is					23	0	0	0

3. Cube quantity of water shut out by the embankment, south side of river, at a spring tide, in feet	12,206,900	
Ditto ditto, north side of river	565,132	
Total quantity of water excluded at spring tides		12,772,032
Cube quantity of water shut out by embankment, south side of river, at neap tides	4,288,880	
Ditto ditto, north side of river, at neap tides	90,800	
Total quantity of water excluded at a neap tide		4,379,680

APPENDIX C.

MONTROSE.

No. 175.
Answers to Mr. Rendel's Queries relative to the Basin and Harbour and Embankments.

4. The same, as increased by the new channel for the river, at spring tides	12,064,766
Ditto ditto, at neap tides	3,672,414

This question cannot be answered quite correctly, as some part of the new channel was above neap tides, but it cannot be ascertained how much.

5. Sectional areas of the harbour channel:—	SUP. FT.
East light-house, *at high water of spring tides*	10,365
West light-house ditto ditto	10,915
Entrance to new dock ditto ditto	20,840
Suspension bridge, stone arch, and drawbridge	11,460
Sectional areas of harbour channel, at—	
East light-house, at low water of spring tides	1,864
West light-house ditto ditto	1,907
Entrance to new dock ditto ditto	6,267
Suspension bridge ditto ditto	4,289
Sectional areas of harbour channel, at—	
East light-house, at high water of neap tides	8,064
West light-house ditto ditto	8,218
Entrance to new dock ditto ditto	17,830
Suspension bridge, stone arch, and drawbridge	9,466
Sectional areas of harbour channel, at—	
East light-house, at low water of neap tides	4,528
West light-house ditto ditto	4,124
Entrance to new dock ditto ditto	11,210
Suspension bridge, stone arch, and drawbridge	6,517

6. Comparative levels of the tides used in all the foregoing calculations, all measured down from the top of the new quay; and the distance of the several points where the observations were made, from the dock entrance:—

—	Distance in Feet from Dock Entrance.		High Water.		Low Water.	
			Springs.	Neaps.	Springs.	Neaps.
Gauge No. 1. Near the mouth of the river, south side	5,300	below	2·5	6·5	..	..
" " 2. Lower light-house	175,0	"	3·3	7·3	19·57	14·0
" " 3. Upper light-house	850	"	3·4	7·35	..	..
" " 4. Dock entrance	"	"	3·3	7·2	19·7	14·0
" " 5. Suspension bridge	2,150	above	3·2	7·05	19·5	13·85
" " 6. Old Montrose pier	13,260	"	3·3	7·35	..	..
" " 7. At top of new embankment	16,700	"	3·2	7·35	..	..
" " 8. At bridge of Dun	19,420	"	3·2	5·8	A fresh.	

The high water of spring tides here given, is the tide of 9th August, p. m., which was the highest tide observed during the survey.

The high water of neap tides, is the tide of 16th August, a. m., which was the lowest tide observed during the survey.

The low water of spring tides, is the tide of 9th August, a. m., and is the lowest ebb observed during the survey.

The low water of neap tides, is the tide of the 16th August, p. m., which ebbed the least of any tide during the survey.

N.B.—On that day there was a fresh in the river. See, as an appendix to these observations, the accompanying tide tables, which give the times as well as the levels of the tides.

The high water of spring tides on 9th August, at No. 1 gauge, is merely computed, that gauge not being put up by that day.

JAMES LESLIE.
W. BLACKADDER.

No. 176.

No. 176.
Rendel, on enclosing Tidal Mudlands, near Old Montrose.

Report of J. M. RENDEL, Esq., C.E., F.R.S., *on the Enclosure of Tidal Mudlands, near Old Montrose.*

34, *Great George-street, Nov.* 24, 1842.

SIR,

YOUR letter of the 18th July last, accompanied by sundry plans and reports, on the subject of an inclosure of tidal mudlands on the shores of the Montrose estuary, by Sir James Carnegie, of South Esk, Baronet, with instructions to me to report thereon, as suggested by the Lords Commissioners of the Admiralty in the Hon. Sidney Herbert's letter of the 15th July, in reply to your letter and memorial of the 6th, reached me at Dundee on the 20th July; and on the 23rd I proceeded to Montrose, and in company with Mr. Leslie, the engineer to the harbour trustees, and Mr. Blackadder, the engineer appointed by Sir James Carnegie to execute the embankments complained of, I made a close inspection of the works, both at low and high water, and of the shores and channels of the harbour from thence to the sea.

Finding that Mr. Leslie and Mr. Blackadder differed in opinion on points which I deemed important to the inquiry, an actual survey, including a measurement of the ground embanked, and a series of tidal observations jointly executed by those gentlemen, became a necessary preliminary to any further proceedings. On the 26th September last, I received the results of their survey properly authenticated, which, with all the other papers submitted to me, I have well considered, and now beg to submit the following Report:—

The estuary in which the works under consideration have been made, is of that class which the sea has formed by throwing up banks of sand across the mouth of a deeply recessed bay, converting the space within into a kind of tidal basin, or salt water lake. The channel which connects it with the sea constitutes the harbour of Montrose, which is kept deep and commodious by the great quantity of water running through it between the sea and the basin during the flux and reflux of every tide.

APPENDIX C.

MONTROSE.

No. 176.
Rendel, on enclosing Tidal Mudlands, near Old Montrose.

This brief but general description will suffice to show that a mutual dependence subsists between the harbour and the estuary. For instance, supposing the harbour to be contracted by injudicious works, so as to prevent a full flow of tide into the estuary, its shores and elevated parts being no longer flowed over, would be covered with vegetation, and rapidly become productive land; and supposing the estuary encroached on in a manner to reduce the quantity of water passing through the harbour, its depth and capacity would, as a consequence, be correspondingly diminished.

Now it appears from the joint survey of Mr. Leslie and Mr. Blackadder, that the embankments making by Sir James Carnegie have reduced the area of the estuary upwards of 62 acres, and the quantity of tidal water flowing into it at spring tides upwards of 10½ millions of cubic feet, and at neap tide nearly three millions of cubic feet. It follows, therefore, as a consequence deducible from the preceding description of the harbour, that this great loss of backwater will be the cause of injury, and that the interference of the harbour trustees was a proper and necessary measure.

The restoration of the land embanked is, perhaps, the only remedy that can be legally insisted on. I am not, however, prepared to recommend it as the best. I would suggest, as a preferable course, that Sir James Carnegie should be permitted to complete his embankments, provided he will undertake the widening and deepening of the new channel of the South Esk river to the extent described by the plan, sections, and specification, which accompany this Report.

The adoption of this compromise, though leaving a loss of backwater at spring tides of upwards of 7 millions of cubic feet, will give an increase of 2½ millions cubic feet at neap tides, whilst from the excavations it imposes being at a level considerably below the greater portion of the embanked mudland, the water gained will be more beneficial to the scour of the harbour and estuary than an equal quantity of that which has been taken away.

That it will be the interest of Sir James Carnegie to adopt this compromise is sufficiently manifest, and I would strongly recommend it to the preference of the harbour trustees, under the circumstance of their having sanctioned the diversion of the South Esk river, which, in the course of years, would infallibly have led to the silting up of its old channel, and the adjoining mudlands which comprise the whole space now embanked.

In conclusion, I feel it my duty to echo the recommendation given by Mr. Walker to the harbour trustees in his Report of the 18th January, 1839, that they should watch with jealousy any attempt at encroachments on the shore of this estuary; and, as the most effectual means of rendering such watchfulness operative, I would recommend that it should be an instruction to their harbour master to make the circuit of its shores at least monthly, and present a written report on the result. And further, that as a means of knowing with exactitude any changes occurring within it from natural causes, levels should be taken on numerous lines between well-defined and permanent marks on the opposite shores, from which sections should be laid down and preserved as official documents, so that by a repetition and comparison every three or four years, changes in its bed and channel, however minute, might be noted and registered.

These are precautions which the importance of the harbour fully justifies, and which its nature requires.

I am, &c.,

JAMES M. RENDEL.

Specification of Works to be done in Widening and Deepening the Channel of the river South Esk, between the Bridge of Dun and Old Montrose.

First.—The present channel of the river is to be widened and otherwise formed to correspond in dimension and shape, with the plans and sections attached hereto.

Second.—The whole of the soil required to be removed in executing the works described is to be taken to such parts of the low ground within the new embankment made by Sir James Carnegie, Bart., as his engineer or agent may from time to time direct; or if such engineer or agent shall deem the excavated soil unsuitable for levelling the embanked land, then the contractor must remove it to such place as the engineer appointed by the Montrose harbour trustees may approve, the deposit being made beyond the reach of the highest known tides, and in such manner that no portion of the excavated soil shall be liable to fall or be thrown into the estuary.

Third.—That both slopes of the new channel from the bridge of Dun to the letters Y Z on the plan, are to be coated or protected with whinstone, in the same way, and to the like extent and thickness, as the north-west end of the new embankment, where it crosses the old channel of the river.

Fourth.—In case any of the soil required to be excavated, in the execution of these works, shall, either from accident or neglect, be washed away by the river, a quantity of soil equal thereto shall be removed from some other part of the estuary as may be decided on, and pointed out by the engineer of the harbour trustees, and the place of deposit for the soil so to be removed shall also be determined by the said engineer, but as near to the place where the excavations are required to be made as a compliance with the restrictions already specified as regulating the deposit of soil will admit of; and

Fifth.—The works are to be commenced on or before the 1st day of April, 1843, and must be completed on or before the 30th day of September of the same year, under the joint superintendence of the engineer to the harbour trustees, and the engineer to Sir James Carnegie; and in the event of any difference or dispute arising between them as to the meaning or intention of any part of the plans, sections, or these specifications, the same shall be referred to an engineer, to be named by the Lords Commissioners of the Admiralty, and his decision to be final and binding on Sir James Carnegie and the harbour trustees.

JAMES M. RENDEL.

No. 177.
Correspondence on Embankments in the South Esk and Montrose Estuary.

No. 177.

MR. ADAM BURNES, *Clerk to the Harbour Trustees, to Sir James Carnegie, of South Esk, Bart., Kinnaird Castle, on the Embankments in the South Esk River.*

SIR,

Montrose, December 20, 1842.

I HAVE the honour, by directions of the trustees of the harbour of Montrose, to address you on the subject of the recent embankments made by you, or under your authority, in the basin or estuary of Montrose; whereby, according to the report of Mr. Rendel, founded on personal inspection, and on the joint statement of the engineers employed by you and the harbour trustees, it appears that upwards of 62 acres of ground have been taken possession of by you, to the injury and prejudice of the harbour of Montrose.

APPENDIX C.

MONTROSE.

No. 177.
Correspondence on Embankments in the South Esk and Montrose Estuary.

I am directed by the trustees to intimate to you, that the Lords Commissioners of the Admiralty have been pleased to signify their approbation of the course recommended by Mr. Rendel, viz., that you should be permitted to complete the embankments in question on the condition that you undertake the widening and deepening of the new channel of the South Esk River, and the whole of the other works described by the plan, sections, and specifications which accompany Mr. Rendel's report; the whole works referred to to be commenced on or before the 1st day of April next, and to be completed at your expense, on or before the 30th day of November same year, in every respect conformably to the said specifications and relative plan and sections, copies of which, as well as of Mr. Rendel's Report, are already in your possession. I am therefore directed to request that you will have the goodness to intimate to me in writing, within 14 days from this date, what course you mean to pursue in regard to the embankments in question, and, in particular, whether you intend to remove these embankments, or to adopt the alternative recommended by Mr. Rendel, of which the Lords of the Admiralty have signified their approbation, as you will observe from the accompanying copies of two letters, dated 9th and 14th instant, addressed to me by Sir John Barrow, one of the joint Secretaries to the Admiralty. I have also to intimate, that the present communication is made on the understanding that the expenses of the surveys and reports, and of any superintendence of works, and of the legal proceedings hitherto had, shall be defrayed by you.

I am directed to assure you, that the trustees of the harbour of Montrose have no wish to interfere unnecessarily with the rights of yourself, or of any other proprietor, whose lands adjoin the Montrose estuary, but as the local guardians of the Montrose Harbour (of which, as of other harbours in the kingdom, the Lords of the Admiralty are the public conservators), they feel it to be their duty to resist any encroachments or enclosure of ground on that estuary, not only as being illegal operations, but as calculated, in the opinions of the most eminent engineers, seriously to injure a harbour which depends mainly, if not solely, for its efficiency on the scour or the discharge of back water from the estuary to the sea.

As certain legal proceedings are in dependence in the Court of Session relating to the encroachments in question, I am under the necessity of intimating that the present communication shall not be held to prejudice or affect these legal proceedings, nor the rights competent to the Lords of the Admiralty or to the harbour trustees to enforce the removal of the embankments in question, should the course recommended by Mr. Rendel not be followed out.

I have the honour to be, &c.,
ADAM BURNES.

Sir James Carnegie, of South Esk, Bart.,
&c. &c. &c.

Correspondence of Mr. ROBERT LYALL, *with the Secretary to the Montrose Harbour Commissioners, relative to the Repairing of Embankments in the Montrose Estuary.*

Montrose, August 20, 1845.

SIR,

I DEEM it to be my duty, as clerk to the Montrose Harbour trustees, to communicate to you the accompanying copy letter, dated 19th instant, addressed to me by Mr. Lyall, factor for Sir James Carnegie, of South Esk, Bart., notifying the intention of Sir James forthwith to strengthen and repair those embankments in the Montrose Estuary which were lately the subject of inquiry before the Tidal Harbours Commissioners. I also beg to report the accompanying copy of my answer to Mr. Lyall's letter.

I have, &c.,
ADAM BURNES.

To the Secretary of the Tidal Harbours Commission.

(Copy.)

Mr. ROBERT LYALL'S *Letter.*

Old Montrose, August 19, 1845.

SIR,

THE embankment lately erected by Sir James Carnegie, at Old Montrose, with a view of protecting his property from the effects of the river South Esk, and the tide having in several places consolidated and sunk down some five or six inches, I think it but right, as a matter of courtesy, to inform the Harbour Commissioners at Montrose, that it is Sir James Carnegie's intention to make up the bank to the original height. There are still some of the stakes remaining that were put in to keep us to the intended level, but what is better is, the stone pier at Old Montrose, which was our guide at the east end of the bank, and the bank formed in 1831 at the west end. May I ask the favour of you to give the above information to the Harbour Commissioners, and to assure them, that it is not intended to raise the bank one inch above the original height.

I am, &c.,
ROBT. LYALL.

To the Secretary to the Harbour Commissioners,
Montrose.

P. S.—I shall make up a piece of the bank, that the Commissioners may see what is proposed to be done.

(Copy).

Montrose, August 20, 1845.

SIR,

I HAVE to acknowledge receipt of your letter of the 19th instant, which I shall lay before the first meeting of the harbour trustees. In the mean time I have only to repeat, that the trustees most decidedly object to the construction or repair of any embankments in the Montrose Basin, as being illegal works, and calculated to do serious injury to the harbour of Montrose.

I remain, &c.,
ADAM BURNES.

Robert Lyall, Esq., Old Montrose.

APPENDIX C.

MONTROSE.

No. 178.
Income and Expenditure.

No. 178.

Return of Income and Expenditure for the Years 1841–2–3.

INCOME. Heads of Income.	1841 £.	s.	d.	1842 £.	s.	d.	1843 £.	s.	d.
Tonnage & plankage dues . .	923	10	1½	910	4	11	894	4	1½
Dues on goods .	2362	5	1½	2342	5	9	2153	5	5½
Steelyard & crane dues . . .	13	16	3	12	13	11	11	9	6
	3299	11	6	3265	4	7	3058	19	1
Lights:— Local dues . .	141	16	11	141	8	8	128	11	6
Total . £	3441	8	5	3406	13	3	3187	10	7½

EXPENDITURE. Heads of Expenditure.	1841 £.	s.	d.	1842 £.	s.	d.	1843 £.	s.	d.
Salaries . . .	223	0	6	226	11	6	374	15	0
Repairs on old harbour, &c. .	103	2	10	30	12	5	57	3	11
Ditto on implements . . .	4	15	10	1	12	9	18	13	6
Rents, feu duties, and income-tax	252	1	6	263	2	5	276	10	10
Printing and advertisements .	27	15	8	4	6	5	8	3	6
Incidental expenses	45	4	6	26	4	6	31	18	2
Compensation to town of Montrose, under Acts	600	0	0	600	0	0	600	0	0
Interest . . .	1310	0	7	1616	10	2	1784	1	5
	2566	1	5	2769	0	2	3151	6	4
Lights:— Light-keeper's salary . . .	52	0	0	52	0	0	52	0	0
Repairs and maintenance . .	27	3	3	39	9	10	26	15	8
Interest . . .	8	19	3	9	3	9	9	9	7
	88	2	6	100	13	7	88	5	3
Total . £	2654	3	11	2869	13	9	3239	11	0

Dues levied by Royal Charter, and Act 1 Vict., c. 99.
Debt due on the 1st January, 1846, 45,650*l.*

ADAM BURNES, *Clerk to the Trustees.*

JOHNSHAVEN.

No. 179.
Income and Expenditure.

JOHNSHAVEN.

No. 179.

Return to Address of the House of Commons of July 29, 1844.

INCOME. Heads of Income.	1841 £.	s.	d.	1842 £.	s.	d.	1843 £.	s.	d.
Shore dues on vessels with coals, including 4*d.* on ballast . .	31	19	7	27	0	0	32	17	8
Ditto with lime . .	5	19	7	7	2	2	9	13	6
Ditto with hemp . .	0	15	3	0	19	3		..	
Ditto with salt . .	0	19	8	2	10	6	2	11	0
Outwards with potatoes	2	10	7	0	13	8	0	9	4
Ditto with herrings .	0	11	9		..			..	
Ditto with barley . .	0	7	10	0	9	4	0	12	11
Total	43	3	10	38	14	11	46	4	5

EXPENDITURE. Heads of Expenditure.	1841 £.	s.	d.	1842 £.	s.	d.	1843 £.	s.	d.
Rings and repairs in harbours . .	0	15	8	0	11	6	7	10	9
Shore-master for collecting . . .	2	8	0	2	3	9	2	11	2
Total . . .	3	3	8	2	15	3	10	1	11

Mr. Brotherton, the proprietor of the harbour, levies the above dues under the authority of a charter.

Creek of Johnshaven, Port of Montrose.

ROBERT PORTER, *P.C.O.*

GOURDON.

No. 180.
Income and Expenditure.

GOURDON.

No. 180.

Return to Address of the House of Commons, of July 29, 1844.

Income.	1841 £.	s.	d.	1842 £.	s.	d.	1843 £.	s.	d.	Expenditure.	1841 £.	s.	d.	1842 £.	s.	d.	1843
Shore-dues on vessels with goods inwards — including 6*d.* per ton on ballast	54	13	4	62	8	9	76	19	9½	See Note.*							
Shore-dues and plankage on vessels with grain, outwards .	45	1	1¾	42	8	11½	95	12	1½								
	99	14	5¾	104	15	8½	172	11	11								

Dues levied under the authority of an Act of Parliament, 4 and 5 Vic., c. 49.
* The expenditure on the harbour during the last three years is stated at 2,000*l.*

ROBERT PORTER, *P.C.O.*

STONEHAVEN.

No. 181.

Return to Order of the House of Commons of August 9, 1844.

Stonehaven, February 8, 1845.

No. 181. Return to Order of the House of Commons, 9th August, 1844.

I. THE Commissioners of the Harbour of Stonehaven have acted, and now act, under and in virtue of an Act of Parliament, 6th Geo. IV., cap. 54, intituled "An Act for improving andmaintaining the Harbour of the Burgh of Barony of Stonehaven, in the County of Kincardine, and the entrance thereto; and rendering more convenient and commodious the Streets and Avenues leading to the same."

II. The said Commissioners have in their possession, and now transmit, as relative to this return, copies of the reports, plans, &c., aftermentioned, viz.:—

1. "Report relative to the Harbour of Stonehaven, by Mr. Stevenson, civil engineer," dated 10th March, 1812; with relative plan for enlarging the harbour, annexed to the report.
2. Survey of the harbour of Stonehaven, with plans and sections showing the proposed improvements, referred to in a report by Robert Stevenson, civil engineer, 1824.
3. Statements for the purpose of obtaining subscriptions for the improvement of the harbour of Stonehaven, 1824.
4. Report by Robert Stevenson, civil engineer, relative to the harbour of Stonehaven, 17th June, 1830.
5. Plan referred to in the said report, 1830.

III. Although there is no doubt that the harbour of Stonehaven is susceptible of great improvement and enlargement, no complaints have been made to the Commissioners as to its defects since it was put in its present state.

JAS. FINDAL, *Clerk to the Commissioners.*

No. 182.

Mr. ROBERT STEVENSON, C.E., *on the best means of Improving the Harbour, with Estimate.*

Edinburgh, March 10, 1812.

No. 182. Stevenson, on the best means of improving the Harbour.

IN the month of November last, when the reporter was inspecting the works of the bridge of Marykirk, in the county of Kincardine, he received an invitation to examine and report upon the state of the harbour of Stonehaven, which pleased him not a little, as the improvement of this harbour may be considered as intimately connected with the safety of the navigation of the Frith of Forth; a subject which has occupied much of his attention for some years past, it being the principal estuary on the eastern coast of Great Britain where the mariner can find shelter when overtaken with a storm in the German ocean.

The reporter has now the honour of submitting to the magistrates and community of Stonehaven, and to the landed interest of Kincardineshire, his report relative to the present condition of the harbour of Stonehaven, and to the improvement of which it seems to be capable.

The bay of Stonehaven is situated upon the coast of Kincardineshire, and at the southern extremity of which the town and harbour of Stonehaven lie, in north latitude 56° 58′, and west longitude 2° 16′. This bay is formed by two projecting points of land, known to seamen by the names of the Garron and Downie points, distant from each other about three miles in a northern and southern direction; and to the westward of a straight line joining these points, it measures three-quarters of a mile in depth. This bay is open and exposed towards the east. The adjoining lands are high and well marked. Its shores consist of coarse gravel and sand, with occasional masses of rock, which occur in the form of what are called *outlyers*. The bottom of the bay is not uniformly clean, but there is an abundant space for anchorage on a clay bottom covered with sand, at the depth of from 4 to 9 fathoms: and as the distance from the land is increased, the water gradually deepens to 16 fathoms, at about one mile from the shore, where there is also good anchorage. The set of the tides upon this coast is north-east and south-west, being nearly in the direction of the shores; and in ordinary spring tides the velocity of the current is about three and a half knots or miles per hour. The perpendicular rise between these extremes of low and high water is about 15 feet. In neap tides the velocity is about one and a half knots, and the rise of the water is about 9 feet.

In describing the present state of the harbour of Stonehaven, it may be observed that it is situated in the south-west part of the bay of Stonehaven—is formed partly by an excavation from a ledge of rocks situated between the efflux of the united streams of the rivers Cowie and Carron on the north, and the high land of Downie Point on the south. On the ledge, part of the town and piers of the harbour are built. The access to this harbour is much encumbered by a large insulated rock, which is covered at high-water, and lies about 20 fathoms south-east from the pier-head. At low water of spring tides, it exposes a surface of about 50 by 30 yards, while its greatest height above low-water mark is about 7 feet. On the north side, the tide does not leave it; but on the south side, it is connected with the shore by large loose stones, which appear at low-water. This rock is emphatically called *Craig-my-care*, and has been the occasion of many fatal accidents. The reporter at this time observed the scattered remains of a coasting-sloop which was lost upon it in the month of October last; and the crew were only saved by clinging to parts of the wreck that washed ashore when the vessel broke up.

The outlines of the harbour, as may be seen by the accompanying plan, include nearly a square space, one side of which is entirely open and exposed to the troubled state of the waters of the bay in storms. On the west side, part of the town stands on the sea-beach, while the other two sides are bounded by the ledge of rocks formerly noticed, on which the piers are built. The extent of these piers is about 500 feet: they are of rude workmanship, formed with stones without mortar, and too small for such an exposure. The piers may be said in some degree to be held together by the repeated use of wooden wedges, liable to decay, and even to change their bulk with every alteration of the weather. The whole of the piers may be considered as in a very perilous condition. They

APPENDIX C.

STONEHAVEN.

No. 182.

Stevenson, on the best means of improving the Harbour.

are without so low as to render it impossible to attend the mooring-ropes of the vessels when heavy seas break over the piers and occasion a *run* in the harbour.

The bottom of the harbour is rock covered with a stratum of sand; and, being only partially excavated, the height of the pier at the north side of the harbour measures only 8 feet, while the pier-head upon the eastern side is 15 feet in height.

This inequality of the bottom so curtails the berthage of the harbour, that it is only capable of containing about twelve or fifteen coasting vessels. These are ranged with their sterns towards the north; and when the tide leaves them, from the rising of the ground they resemble so many boats drawn upon a beach—a position which must be injurious to loaded vessels; and as the stem moorings pass in an oblique direction to the mooring-pawls upon the west side, when there is a *run* in the harbour in bad weather the vessels get into motion, and unavoidably destroy one another.

At Stonehaven, the complaint is not so much the want of a sufficient depth of water to admit coasting vessels into the harbour (for at high water of spring tides there is from 14 to 16 feet water, and from 7 to 9 during neap tides): its chief disadvantages are the difficulty which attends the access to the harbour from the sunken rock formerly noticed, together with its almost total want of security to shipping when the waters of the bay are agitated by a storm from the east-north-east, the harbour being entirely open towards the south. Accordingly, all the vessels in the harbour, during the great storm of October last, received less or more damage; and the reporter saw one vessel drawn up on the beach with her bottom laid quite open with beating upon the ground in the harbour.

This may, therefore, be considered as unsafe a harbour as any upon the coast; calculated, indeed, to make hardy seamen, but expensive *ships' husbands;* and nothing but the adventurous spirit of the merchants and shipowners of Stonehaven can account for their continuing under so many disadvantages to risk their property in the manner they do.

Having seen the dangerous and incommodious state of the harbour of Stonehaven, it will now be proper to consider the best means for rendering it more accessible, more safe for vessels when in it, and so to enlarge it as to meet the rising prosperity of the county of Kincardine, of which Stonehaven is every way calculated for becoming the port.

Any plan for the improvement of the present harbour ought to embrace the removal of Craig-my-care rock, or a considerable portion of it, to a level with low-water of spring tides, so as to render the access to the harbour more safe and easy. This rock is an irregular mass of sandstone, of a red colour, and in other respects resembles the quarries on the south side of the bay. It would answer very well for mound-stones, or hearting for the new piers.

Although in the original construction of this harbour the piers are laid out in such a manner as to ward off the heavy breach of the sea in a northerly and easterly direction, yet they are incommodiously low, and so insufficient, that, in any substantial view of this harbour, these piers would require to be renewed upon a smaller scale, yet agreeably to the design of the section on the plan; and as the stones of which it is composed are not weighty enough for outside work, they would fall to be used only as hearting for the new work.

The bottom of the harbour would likewise require to be excavated, till the whole is brought to the level of the entrance of the harbour. By this means the harbour will contain a greater number of vessels, and they will be less liable to receive damage in taking the ground. But, owing to the open and exposed nature of the harbour on the south side, these repairs and alterations would have no effect in preventing the agitation of the waters in the harbour. It would therefore be necessary, in connexion with these works, to extend the head of the pier on the east side of the harbour about 60 feet, in the form marked in dotted lines upon the plan. The proposed addition is turned in a south-west direction from the present pier, that it may the better deflect the waves from their course round the pier-head. Still further, as the agitation in the harbour can only be prevented by shutting out the waters of the bay, in so far as this can be done consistently with the free and convenient access of the harbour, it is proposed to project a pier from the west side, and extend it about 200 feet in an easterly direction. This pier would check the circular sweep of the waters at the head of the bay from being spent in the harbour. A capstan placed upon this pier-head would be of much service in warping vessels into the harbour. In this manner the present harbour may be made to contain about twenty-five coasting vessels; and the agitation of the waters in the harbour would be considerably lessened. But still this effect would be incomplete, because the new or western pier cannot be brought so near the present piers as sufficiently to exclude the waves, without rendering the access to the harbour extremely difficult, and even dangerous.

Stones for these operations can fortunately be got quite contiguously, from an excellent sandstone quarry immediately opposite the harbour, and almost within high-water mark, which, when fully opened, will afford abundance of excellent materials.

The expense of these operations, from the annexed estimate, appears to amount to 4046*l.* 1*s.* 11*d.*

Lest it should be thought proper to put a *boomgate* upon this harbour, as has been suggested, the new pier is kept at such an angle with the entrance of the harbour as to afford *some* shelter to vessels requiring to be grounded, or, as it is termed, *stilled* upon the beach, before entering the harbour. A boomgate would unquestionably preserve the waters of the harbour in a quiescent state; but the narrowing the mouth of the harbour to answer this, from its local situation, would render the access too intricate; and the grounding of loaded vessels would in many instances endanger their safety. The Reporter would not therefore be understood as recommending the application of a boomgate for this situation, where there is no outer harbour nor breakwater. The present harbour might be still further enlarged by the removal of the pier on which the granaries stand; and a run of water might be introduced into it by a covered way from the river, for the purpose of scouring the bottom; but neither this extension of the harbour, nor the expense that would attend the construction of the boomgate, are estimated.

The Reporter, aware of the state of the financial concerns of the town of Stonehaven, has been desirous to accommodate his plan for the improvement of its harbour, as much as possible, to the prospects of the magistrates. But he is sorry to say that, after all his endeavours, such are the local circumstances of the place, that, although capable of being a safe and commodious harbour, this cannot be accomplished without the expenditure of a sum very considerably beyond what was quoted to him as a maximum. From the great expense unavoidably attending the operations confined to the

APPENDIX C.

STONEHAVEN.

No 182.

Stevenson, on the best means of improving the Harbour.

improvement of the present harbour, and from the insufficient nature of the accommodation which its best condition would afford, the Reporter ventures to call the attention of those interested in the prosperity of Stonehaven to a design calculated to render the harbour extensively useful, independent of the present harbour, which by this plan is left untouched; and may, in connection with the plan about to be proposed, become extremely useful for the berthage of the smaller craft frequenting the place.

This design, as may be seen from the drawings, includes upwards of 15 acres of the bay, which will be flooded with water every tide, affording ample space for any agitation of the waters to expend, without disturbing the shipping, with all the advantages of a copious supply of back water—an effect that cannot be obtained, where the surface of a harbour is small, unless it be constructed in the form of a wet dock. The piers of this extended harbour are made to cross part of the bay, just far enough to the eastward of the present harbour to obtain sufficient depth of water to admit the smaller-sized coasting vessels, at low water of spring-tides, whose draft of water does not exceed 7 feet, and at high water there will be a depth of 22 feet; consequently such a harbour would admit of sloops of war at half-tides.

For the berthage of vessels, there will be an acquisition of 900 feet of quays, and it may be made to accommodate about 100 coasting vessels.

This extension of the harbour is formed by carrying a pier 600 feet, or thereby, in a south-easterly direction, from the outer wall on the south side of the present harbour, when it takes a south-westerly direction, and forms the north pier-head of the new or extended part of the harbour. From the south side of the bay another pier is projected 150 feet towards the north-west, which becomes the southern pier; the mouth or entrance of the harbour being forwarded by the approach of these two piers. By extending a quay along the rocks at low-water mark, from the south end of the quay, on the east side of the present harbour, till it joins the new north pier, the outer and inner harbours will be connected, and a space of rocks enclosed, which may be converted to useful purposes, such as the erection of warehouses; and a graving-dock for the repair of ships may be excavated in it.

To estimate the expense of these operations with accuracy, it would be necessary to have a more particular survey of the bay, with a greater number of soundings relative to the depth of water, than the Reporter has had any opportunity of obtaining; but from the observations which the Reporter has been enabled to make, and from the contiguity of excellent sandstone quarries, already referred to, it is expected that the sum of 48,253*l.* 6*s.* 6*d.* will cover the expense of these operations. A detailed estimate will fall to be made out, with specifications of the work, agreeable to the plan resolved upon; and the Reporter doubts not but further improvements may be suggested upon going over the ground a second time.

The above sum is no doubt a large one; but the advantages to be derived from its expenditure are proportionably great: the establishment of a harbour capable of admitting coasting vessels at all times of tide, and the lower classes of His Majesty's ships of war at high water, are advantages which few harbours upon the east coast of Great Britain possess, that are not liable to have their navigation interrupted by floods of fresh water, from their connection with rapid rivers.

The harbour of Stonehaven is capable of much further extension than the plan already described refers to. It may be made upon the plan of an outer and an inner harbour, which together will contain about 150 vessels, and afford a depth of water sufficient for the admission of sloops of war at half-tide.

This extensive design the Reporter shows in dotted lines upon the plan; the expense of which he does not at present calculate, not having sufficient data, as the state of the weather, and his limited stay at Stonehaven, in the month of November, did not admit of his taking soundings of the depth of the water in the direction of the piers sufficiently numerous for this purpose.

The advantages to be derived to the town and immediate neighbourhood of Stonehaven, from the improvements of its harbour, are so evident, that, along with its rapid advancement in population and manufactures, it seems strange that so great an obstacle to its progress in commerce should not, at least in part, have been already removed.

The prosperity of the place, and the value of property in its neighbourhood, cannot be expected to increase in the manner they would do, were the harbour enlarged, and the shipping which frequent it rendered secure. In the present state of the harbour, men of enterprise and capital will not extend their mercantile concerns, while other spirited individuals must be prevented from settling in this place, although there be as fair a prospect for the merchant and the fisher at Stonehaven as at any port on the coast. With a better harbour, and the exertions of a few merchants, such as have appeared in its neighbourhood as the improvers of the soil, a new field would be opened for the supply of a rich county, where a great proportion of the proprietors are resident; and the present languid state of the fisheries on this coast would receive fresh vigour and life. By a further extension of its manufactures, and taking advantage of the water-falls in its vicinity, Stonehaven would soon enjoy a direct communication with the metropolis, without which the merchant and the manufacturer can never reap the full benefit of their speculations, but must labour under the hardship of expensive charges, and the numerous disadvantages which attend protracted land-carriage.

The value of a direct shipping trade to London may be estimated from establishments of this kind in the adjoining county of Forfar, as at Dundee, Arbroath, and Montrose, from all of which places there is a direct trade to London, although the stretch of coast is only of similar extent with that of Kincardineshire.

Whatever tends, even remotely, to the increase of the population and prosperity of any particular district of a county, must interest the proprietor of the land; but the improvement of the harbour of Stonehaven has a direct tendency to benefit the farmer, by enabling him to procure lime and fuel, and to send his surplus produce both speedily and economically to the best market. The county of Kincardine is somewhat singularly circumstanced with regard to its harbours; although bounded by the sea fully thirty miles, it has not one harbour calculated to afford shelter and security to the most trifling bark in a storm. The commercial intercourse of the county is, therefore, chiefly through the ports of Montrose and Aberdeen, situated at the northern and southern extremities of the adjoining counties; and the central parts of Kincardineshire labour under all the disadvantages of an expensive land-carriage in their commercial intercourse. It is a fact of which the Reporter has been informed, that, in consequence of the insufficient accommodation in the harbour of Stonehaven, vessels cannot be freighted to export grain from thence, unless at a much greater expense than at other ports on the coast, so that the farmer in the neighbourhood of Stonehaven is obliged to sell his produce at a

APPENDIX C.

STONEHAVEN.

No. 182.
Stevenson, on the best means of improving the Harbour.

price inferior to that of his neighbours, in proportion to the increased rate of freight which the grain-merchant at Stonehaven must pay. A better harbour at Stonehaven would remove all these inconveniencies. It further happens, that the sea-shores of the county are chiefly of granite, or consist of sandy bays, which are both inimical to the growth of sea-ware, only small quantities of which are therefore to be produced for agricultural purposes; so that the improvement of the land almost solely depends upon the use of lime; and limestone is rather of rare occurrence in the county, and at any rate is unaccompanied with coal. The supply of coal and lime (these indispensable necessaries to the operations of the husbandman and the manufacturer) must therefore be sea-borne. The disadvantages which must ever attend the loading and discharging of vessels in an unsafe harbour, which can only be entered at particular seasons of the year, and thereby trench upon the regular business of the former, are but too often experienced in this county to require illustration. What has now been stated will show the multifarious benefits which would attend the formation of a commodious harbour at Stonehaven to the landed interest.

To show the advantage which must accrue to the general trader upon the east coast of Great Britain, by such an improvement upon the harbour of Stonehaven as would at low water admit of coasting vessels, it may only perhaps be necessary to reflect on the numerous losses which occur every winter upon this coast from the want of such a convenience; for between the bay of Cromarty and Leith roads, and between these again and the Humber, the harbours are all either tide-harbours, or such as are liable to be obstructed by shifting sands and the efflux of strong currents, from their connection with the rivers. It therefore happens that vessels on the eastern coast, when overtaken with an adverse wind, are obliged perhaps to repeat a tedious passage for shelter to one or other of these estuaries, when a good harbour at Stonehaven, so near the entrance of the Frith of Forth, would not only render this unnecessary, but would likewise be the means of saving many valuable lives and much property.

To take a still more extended view of the local advantages of the bay of Stonehaven, and the improvement of which the harbour is susceptible, it may be stated, that it is capable of becoming a rendezvous for some of the lower classes of His Majesty's ships of war allotted to the protection of the trade in the north seas, as there will be about 17 feet water at half-tide, and 25 feet at high water, between the pier-heads, by the plan represented in dotted lines. Now the usual draft of water of frigates and sloops of war, with six months' provisions on board, is from 14 to 18 feet.

The bay of Stonehaven affords very good anchorage with *off-shore* winds; and the access from the open sea to the harbour is so immediate, that a tack or two will enable vessels to *clear the land* if the weather be any way moderate. Although the Reporter would by no means be understood to hold this up as a naval station, yet for the accommodation of a cruiser or two it unquestionably holds out advantages, in a public point of view, which no other place upon the north-east coast of Scotland possesses in an equal degree. Situated near the north-east entrance of the principal estuary on the eastern coast of Great Britain, its connexion with the German Ocean and North Sea is immediate. Instead of lying from 30 to 50 miles up the Frith of Forth, or Murray Frith, as in the roads of Leith, or Cromarty Bay, Stonehaven is in this respect well situated for becoming an intermediate station between Leith and the Orkneys, at such a distance to the northward that the admiral on the Leith station could communicate with the commanders of ships at Stonehaven with greater facility than the Board of Admiralty can do with Yarmouth, especially if telegraphic signals were instituted, the local circumstances of the intervening land being highly favourable to such an establishment.

These matters, when duly considered, hold out great inducements for the town of Stonehaven, and the landed interest in its neighbourhood, together with such advantages to the shipping and commercial interests in general, and likewise to the public service of the country, that it is hoped means will be adopted for raising the necessary funds to carry into effect a work of such unquestionable utility.

The harbour-dues of Stonehaven yield at present only about 100*l.* sterling per annum. The tonnage-rates are low, compared with the present value of money and the expensive nature of building operations; but in the present condition of the harbour, the dues exigible seem to bear heavy enough upon the vessels that frequent it, compared with the security it affords. As a proof of this, the Reporter was informed by a shipmaster, that the damage which his vessel had received while moored in the harbour during a storm, in the month of October last, would cost 40*l.* sterling for repairs: it was further added, that all the vessels then in the harbour had received damage more or less, and one vessel in particular had her bottom laid quite open by beating on the ground. Yet such are the facilities of access to Stonehaven harbour, that even in its present state, under all these disadvantageous circumstances, it is much resorted to by vessels of a small draft of water; and the Reporter was witness to a loaded brig getting into Stonehaven, which, after waiting a day or two in Aberdeen Bay to get into Aberdeen, was obliged to slip her cable and run for Stonehaven, where she entered in safety.

It would be a matter purely of conjecture to say what increase of revenue might be made from an improved state of this harbour. It is certain, however, that the direct trade of the town of Stonehaven would be greatly increased, while coasting vessels taking occasional refuge in it would perhaps rise in the proportion of a hundred to one. As a collateral inducement to vessels of this description entering this harbour, it may be noticed, that Stonehaven is about 2 miles north from Dunnottar Castle, which is the northern limit of collection for the light upon the island of May, to which Scots vessels pay three halfpence per register ton of light-dues; and English and Irish vessels pay threepence per ton, as foreigners.

Some judgment may be formed as to the shore-dues of Stonehaven, were there a good harbour established there, by comparing it with Arbroath, which is merely a tide harbour, and only the third harbour of the adjoining county of Forfar. At Arbroath, for many years past, the harbour-dues have been let for upwards of 700*l.* sterling per annum. With the advantages attending the improvements of the harbour of Stonehaven, it may reasonably be expected that the annual revenue will amount to not less than 1000*l.*

Although such a sum would fall short of a sufficient return for the full improvement of this harbour, yet, as such a measure would manifestly be a very great national benefit, it is surely not too much for the community of Stonehaven, and the landed interest of the county of Kincardine, to look forward to public aid in a measure of this kind, especially when several of the counties to the northward have been enabled by this means to carry works of a similar nature into effect.

APPENDIX C.
STONEHAVEN.
No. 12.
Stevenson, on the best means of improving the Harbour.

The Reporter will conclude with observing that there cannot be a more useful work between the Thames and the Orkneys than the establishment of a safe and commodious barbour near the entrance of the Frith of Forth, such as the one which is the subject of this report, which might be entered by coasting vessels at all times of tide, and even by the lower classes of His Majesty's ships of war at half-tide.

ROBERT STEVENSON.

Estimate of the Expense of building a Jetty to the Pier on the east side of the Harbour of Stonehaven, and of projecting a Pier or Breakwater on the west side, deepening the Harbour, and rebuilding the present Piers, agreeably to a plan and specification of the work.

	£.	s.	d.	£.	s.	d.
To cutting rock, and preparing the foundation of the outward walls of the jetty, on the eastern side of the barbour of Stonehaven, being 372 superficial feet, at 6*d*.	9	6	0			
To 7440 cubic feet of squared masonry, laid in mortar, in outward walls, at 9*d*.	279	0	0			
To 791 cubic yards of mound-stones for bearting between the outward walls, at 5*s*.	197	15	0			
To 600 cubic feet of squared masonry in parapet walls, at 10*d*.	25	0	0			
To 900 feet of pitching work over the mound-stones, for the top of the pier, at 7*d*.	26	5	0			
To contingencies	55	0	0			
To jetty for the pier on the eastern side of the harbour				592	6	0
To preparing the foundation of the outward walls of pier or breakwater on the western side of the harbour, being 2425 superficial feet, at 1*d*.	10	2	1			
To 12,750 cubic feet of hammer-dressed stone, laid without mortar, in outward walls, at 7*d*.	371	17	6			
To 1126 cubic yards of mound-stones for hearting between the outward walls, at 2*s*. 6*d*.	140	15	0			
To 2280 cubic feet of squared masonry in the parapet, at 9*d*.	85	10	0			
To 3800 feet of pitching over the hearting on the roadway, at 10*d*.	158	6	8			
To a , with its fixtails and tackle for warping vessels	42	0	0			
To contingencies	35	17	0			
To projecting a pier on the western side of the barbour, agreeably to a plan and specification				844	8	3
To excavating 3333 cubic yards of rock, and upfilling in the bottom of the harbour, to reduce it to a level with the entrance of the harbour, at 3*s*.				499	19	0
To cutting rock, and preparing the foundation for rebuilding the outward wall of the pier on the eastern side of the barhour, being 1200 superficial feet, at 6*d*.	30	0	0			
To 18,000 cubic feet of squared masonry, laid in mortar, in outward walls and parapet, at 9*d*.	675	0	0			
To rebuilding 1407 cubic yards of hearting, at 1*s*.	70	7	0			
To 3800 feet of pitching work on the roadway, at 7*d*.	110	16	8			
To contingencies	88	12	0			
To rebuilding the pier on the eastern side of the barbour, exclusive of the jetty				974	15	8
To cutting rock, and preparing the foundation for outward walls of the pier on the northern side of the harbour, being 1800 superficial feet, at 6*d*.	45	0	0			
To 18,000 cubic feet of squared masonry, laid in mortar, in outward walls and parapet, at 9*d*.	675	0	0			
To 1444 cubic yards of hearting for the piers, at 2*s*.	144	8	0			
To 5700 feet of pitching for the top of the pier, at 7*d*.	166	5	0			
To contingencies	104	0	0			
To rebuilding the pier on the northern side of the harbour				1,134	13	0
	Total			£4,046	1	11

Abstract of Estimate.

	£.	s.	d
To jetty for the pier on the eastern side of the harbour	592	6	0
To pier, or breakwater, on the western side of the harbour	844	8	3
To excavating the bottom of the harbour	499	19	0
To rebuilding the pier on the western side of the harbour, exclusive of the jetty	974	15	8
To rebuilding the pier on the northern side of the harbour,	1,134	13	0
Total	£4,046	1	11

No. 183.

Statement of the Capabilities of the Harbour, for the purpose of obtaining funds, by subscription, for its Improvement.

No. 183.
Statement for obtaining funds to improve the harbour.

1824.

FROM its natural situation, the harbour of Stonehaven is accessible to vessels, in stress of weather, when the approach to most other harbours, between the Moray Frith and the Frith of Forth, is dangerous, or altogether impractible: but its usefulness in this respect is much lessened by the insecurity arising from its want of proper piers and moorings—a circumstance by which vessels are deterred from resorting to it in the winter months, frequently, it is feared, to the loss of lives and property. Some years ago, Robert Stevenson, Esq., Civil Engineer, surveyed it, with a view to its improvement; and, in his report on that occasion, he observed, that, "between the Bay of Cromarty and Leith Roads, and between those again and the Humber, the harbours are either tide harbours, or such as are liable to be obstructed by shifting sands, and the efflux of strong currents, from their connexion with rivers. It therefore happens, that vessels on the eastern coast, when overtaken with an adverse wind, are obliged perhaps to repeat a tedious passage, for shelter, to one or other of these estuaries, when a good harbour at Stonehaven would not only render this unnecessary, but would likewise be the means of saving many useful lives and much property."

The benefit which the adjacent districts of country would reap from such a harbour is sufficiently obvious. On this point Mr. Stevenson makes the following observations:—"The county of Kincardine is somewhat singularly circumstanced with regard to its harbours. Although bounded by the sea fully thirty miles, it has not one harbour calculated to afford shelter and security to the most trifling bark in a storm. It is a fact of which the reporter has been informed, that, in consequence of the insufficient accommodation in the harbour of Stonehaven, vessels cannot be freighted to export grain from thence, unless at a much greater expense than at other ports on the coast; so that the farmer in the neighbourhood of Stonehaven is obliged to sell his produce at a price inferior to that of his neighbours, in proportion to the increased rate of freight which the grain-merchant at Stonehaven must pay." A better harbour at Stonehaven would remove all these inconveniences.

In every point of view, therefore, the improvement of this harbour is an object of general importance. This improvement those now in the management of the town are anxious to promote; and, in forwarding it, they hope for the support of the public, and particularly of the shipping interest, and of those more immediately concerned in the prosperity of the county of Kincardine, and certain districts of Aberdeenshire, to which a good harbour at Stonehaven, the nearest seaport, would be beneficial.

A plan of the requisite improvement has been obtained from Mr. Stevenson, and preparation has been made for an application to the approaching session of Parliament for an Act to carry his plan into execution. But the funds of the town being inadequate to the expense of the work, which it is supposed will amount to about 7000*l.*, it is found necessary to solicit the aid of a public subscription. Donations, of any amount, will be acceptable; and for subscriptions of 100*l.*, or upwards, the subscribers shall, if they require it, receive assignments to the harbour-dues, bearing interest from the period at which any preferable debt it may be necessary to incur shall be paid off.

The subscribers agree, so soon as an Act is obtained for improving the harbour of Stonehaven, to pay to the treasurer, to be named under that Act, the sums annexed to their respective signatures, to be applied towards the expense of the work.

No. 184.

Second Report by ROBERT STEVENSON, Esq., C.E., *on the state of the Harbour and its Improvement.*

No. 184.
Stevenson's Second Report on the state of the Harbour.

Edinburgh, June 17, 1830.

HAVING been, at Aberdeen in the latter end of last month, the reporter, agreeably to a correspondence with the harbour trustees and the directors of the bank, visited Stonehaven, where he had an interview with Messrs. Christian and Tindal; and having examined the harbour, he attended particularly to the state and condition of the return-head of the southern pier.

By looking into the accompanying plan of the harbour of this date, it will readily appear, that the want of the jetty intended by the original plan to have been connected with the north pier exposes the southern pier and the interior of the harbour very much to the surge of the sea. The reporter therefore recommends that this jetty, as laid down in dotted lines upon the plan, be now built, or that a breakwater be constructed in the interior of the harbour, in connection with the southern pier, as also delineated in red colour upon the plan. The former of these works, viz. the northern jetty, was originally estimated at 1442*l.* 3*s.* 1*d.*, and the interior breakwater now proposed is estimated at 851*l.* 18*s.* In the present state of the funds of this harbour, it may therefore be advisable to adopt the execution of the interior breakwater, agreeably to the section on the line A A.

After a careful examination of the return head of the southern pier, it seems to have been considerably tried by the great weight of sea with which this coast is visited, which is represented as rising in sprays to the height of about 100 feet, after breaking upon the south pier-head. The reporter finds that it will be necessary in the mean time to make a temporay repair upon this return-head, by drawing or removing several of the stones of the outward face-wall, replacing them with sound materials, and securing them by cross bars of iron. Unless this repair be made in the course of the current season, this pier will be left in a very precarious state for withstanding the storms of winter. The reporter estimates this work, and laying some additional mound-stones along the foundations, at 50*l*; but as the stones of the quarry at Stonehaven are not of a very workable kind, and it may be found necessary to bring those for the face-wall from Aberdeen, it may be proper to add 20 per cent. to this estimate, making it 60*l.* for this compartment of the works.

In the course of the ensuing winter, preparations should be made for adding a bulwark to the outward face-wall of the return-head, as shown in the plan and section on the line B B, now to be repaired in a temporary way. This work, which will require to be executed in the summer of 1831, is estimated at 360*l.* 16*s.*

Excavations to a great extent have been made upon the rock called Craig-my-care, as marked on

No. 184. Stevenson's Second Report on the state of the Harbour.

the plan, having been let as a quarry to the builders of Stonehaven. The reporter considers that it would be injurious to carry these excavations much farther, and recommends that they be entirely confined to the northern margin of this rock, as delineated in red colour upon the plan.

Were these works executed so as to ensure the safety of the pier-head, and render the interior berthage for vessels easy, there can be no doubt that the number of wind-bound ships frequenting Stonehaven would be greatly increased. It therefore seems to be the direct interest of those connected with the prosperity of this place forthwith to accomplish these operations.

ROBERT STEVENSON.

To the Harbour Trustees of Stonehaven.

No. 185.

The Memorial of the Parliamentary Commissioners and Trustees for the Harbour of Stonehaven, in the County of Kincardine, to the Tidal Harbours Commissioners.

No. 185. Memorial of Harbour Trustees to Tidal Harbours Commissioners.

Stonehaven, Sept. 25, 1846.

THE harbour of Stonehaven was formerly under the sole management of the magistrates and feuars of the town, by whom a grant of it was obtained from the Earl of Marischall in the beginning of the seventeenth century.

Although enjoying peculiar natural advantages, this harbour had been very little improved by art; and, consequently, while from its favourable locality it was accessible as a place of refuge to coasting vessels in easterly gales, when no other harbour between the Frith of Forth and the Murray Frith could with safety be approached, its internal accommodation was so insufficient as greatly to deter vessels from frequenting it on ordinary occasions.

In the year 1812 Mr. Robert Stevenson, C. E., was employed to make a survey, with a view to such improvements as might render the internal accommodation commensurate with the natural superiority of the harbour; and he then furnished a Report and relative Plan, to a copy of which, herewith submitted, the Commission is respectfully referred.

Unfortunately, the funds requisite for accomplishing this plan were not attainable.

The harbour therefore remained in its originally imperfect state until the year 1825, when a modified plan for its improvement having been furnished by Mr. Stevenson, and the requisite funds having been provided, an Act of Parliament was obtained, vesting the harbour in certain Commissioners and Trustees, and authorising the execution of that plan.

Copies of the Act and relative Plan are herewith laid before the Commission.

With the exception of a proposed extension of the old, and formerly the only pier, on the north side of the harbour, the works thus projected by Mr. Stevenson, and sanctioned by Parliament, were executed, and, in addition to them, there has been erected about 1000 feet in length of sea-wall along the west side.

Subsequently, two jetties were built; the one running westward and inward from the outer end of the south pier, and the other extending towards it from the land; leaving between them an opening of 50 feet. By these jetties an inner harbour with still water has been formed, in which vessels lie moored, and load and discharge in security. The other division, or outer harbour, also accommodates vessels when occasion serves. The area of both is about 5 acres.

With the sanction of the Board of Northern Lights, leading lights have been provided. They are found of great benefit to vessels taking the harbour, and even useful to vessels passing north to Aberdeen, which, by keeping the lights in a certain bearing, are enabled to direct their course with precision, without the risk of running too near the land, or, for avoiding that risk, taking too great an offing.

By all these improvements, this harbour, at a cost of upwards of 9000*l*., has been rendered commodious for the trade of the place, and instead of being as formerly, from its internal insufficiency, rather shunned, unless on occasions of imminent emergency, it now proves an acceptable refuge to wind-bound vessels at all times, and its easy approach has been the means of saving many vessels from destruction.

The Memorialists would not, on their own judgment alone, have presumed to suggest the locality of this harbour as being more than any other between the two Friths suitable for a harbour of refuge. They are, however, emboldened to submit it in this respect, for the consideration of the Commission, by the concurring opinions of many intelligent and disinterested seafaring men conversant with the contingencies of the navigation of this coast, and more especially are they encouraged by the opinion of Mr. Stevenson, as expressed in his Report, to which they have already taken the liberty of referring.

Mr. Stevenson's professional eminence, and his familiar acquaintance with all the means by which the convenient and safe navigation of the east coast of Scotland may be promoted, are well known, and his strong recommendation of this harbour for an establishment similar to what is now in view was given upwards of 30 years ago, long before the locality of harbours of refuge was matter of public discussion, and long before any competition for a preference in the choice of their locality was, or could have been, heard of.

By all the information and authority to which, in the course of a careful inquiry, the Memorialists have found access, they are confirmed in their own belief that, of all situations between the Frith of Forth and the Murray Frith, the locality of this harbour is the most eligible for a harbour of refuge.

For, in the first place, situate midway between the two Friths, it presents the most central and accessible place of refuge to vessels which, overtaken by adverse weather on the intervening range of coast, are unable to make either of these estuaries.

Secondly: having regard to the very extensive shipping-trade of Aberdeen, a much greater number of vessels, liable to the contingencies of adverse winds and a lee shore, pass through the bay of Stonehaven, than have occasion to pass near any other port to the north of Stonehaven.

Thirdly: it may warrantably be assumed as an unquestionable fact, that this harbour offers a safe refuge in easterly storms, when *no other harbour between the two Friths is accessible.*

Fourthly: taking advantage of the protection already existing in the projecting headland embracing

APPENDIX C.

STONEHAVEN.

No. 185.
Memorial of Harbour Trustees to Tidal Harbours Commissioners

the harbour and a part of the bay on the south, an extension of works sufficient for a harbour of refuge can be accomplished with facility and at a moderate expense.

On these grounds, the Memorialists respectfully desire to bring the case of Stonehaven harbour under the consideration of the Commission.

By authority of a General Meeting of Harbour Commissioners,

PET. CHRISTIAN, *Chairman.*

No. 186.
Income and Expenditure.

No. 186.

Return of Income and Expenditure for the Years 1841-2-3.

INCOME

Heads of Income.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Tonnage dues on vessels	54	0	11	56	11	1	54	10	10
Ballast dues . .	17	5	6	22	14	7	17	2	10
Dues on exports .	147	12	6	113	2	11	88	19	2
,, on imports .	252	7	5	220	8	8	225	17	7
Total . . £	471	6	4	412	17	3	386	10	5

EXPENDITURE.

Heads of Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Salaries to officers .	52	17	0	52	17	0	52	17	0
Repairs and works .	33	6	8	17	1	11	2	10	10
Materials . . .	4	18	0	1	1	0	0	18	3
Guiding lights . .	2	14	0	0	15	6	5	7	9
Cleaning harbour .	16	14	2	3	7	7	7	1	8
Warehouse rent . .	2	2	0	2	4	0	3	0	0
Miscellanies, including advertising, stamps, &c. . .	3	2	8	4	7	5	3	4	9
Total . . £	115	14	6	81	14	5	75	0	3

The dues are levied under an Act of Parliament, passed 20th May, 1825.

JAS. TINDAL, *Clerk to the Harbour Commissioners.*

No. 187.
Evidence taken on the 26th Oct., 1846.

ABERDEEN.

No. 187.

Examining Commissioner.—Captain Washington. R.N., F.R.S.

Present:—The Lord Provost; A. Hadden, of Persley, Master of Shoreworks; Baillie Forbes; Baillie Henry; Baillie Williamson; J. Angus, Town Clerk; A. Gibb, Civil Engineer; A. Henderson, Advocate; A. Torrie, Advocate; D. Chalmers, of Westburn; A. Anderson, Advocate; R. Mitchell, Shipowner; W. Fraser, Merchant; W. Gordon, Ship and Insurance Broker; A. Black, Merchant; R. Catto, Shipowner: J. Leslie, Manufacturer; The President of the Society of Advocates; The Convener of the incorporated Trades; T. Richmond, Inspecting Commander of the Coast Guard; The Collector and Comptroller of Her Majesty's Customs. Lieutenant Sanderson, R.N., Coast-Guard, Don Station; Dr. McGillivray, Professor of Natural History, Marischal College; G. Davidson, Merchant; W. Allardyce, Merchant; W. Hood, Ship-builder; Leslie Clark, Merchant; J. Buyers, Shipowner; A. Duthie, Ship-builder; R. Matthew, Manager of the Aberdeen and London Steam Navigation Company; G. Thomson, jun., Shipowner and Iron-founder; J. Hector, and A. Hector, Tacksmen of Salmon-fishings; A. Martin, Manager of the Merchant Seamen's Fund; The Captain Pilot of Port: The Harbour-Masters of the Port; The Keeper of the Girdleness Light; The Keeper of the Harbour Leading Lights; The Keeper of the Tidal Pier Light and Flag; A. A. Symmers, Shipowner and Shipmaster; A. Morrison, late Master of the "City of Aberdeen" London Steamer; J. Berry, Nautical Instrument Maker, &c.

[*Detailed plans of the harbour on a large scale, showing the intended alterations, were laid on the table; a model of the works and of the entrance of the harbour, with the proposed breakwater by* Mr. Abernethy, C.E., *was also exhibited.*]

Mr. Angus, Town Clerk, examined.—Has been clerk to the harbour for about twelve years. The harbour and all its property belong to the town, in virtue of various royal charters confirmed by subsequent Acts of Parliament. It is at present so held, subject to the existing Harbour Act. The first Act of Parliament obtained for "deepening, cleansing, and making more commodious the Harbour of Aberdeen, for erecting piers, quays, &c.," was in 1773. In 1795 another Act was obtained for altering and enlarging the powers of the previous Act. In 1797 another Act was obtained, chiefly for the purchase of properties in and about Footdee. Then came the Act of 1810, which was the leading Act for the improvement of the harbour. It contemplated the erection of wet docks, graving-docks, extending the north pier, making new quay walls, altering the course of the river Dee, &c., according to a plan of Mr. Telford. In 1813 a Supplemental Act was got to authorize the purchase of properties at Footdee required for these operations. In 1829 an Act was obtained for continuing the improvements of the harbour, according to a plan by Mr. Telford; and then the existing Act (1843) was passed to complete the improvements, by the construction of a wet dock and the various other works now in progress, according to the plan of Mr. Abernethy, the resident engineer. The management of the harbour, up to the Act of 1829, was vested in the Magistrates and Council. By that Act, five Burgesses of Guild, and one member of the Incorporated Trades, elected by these bodies respectively, were conjoined with the Council in the management. Mr. Angus then, at the request of the Commissioner, gave an explanation of the causes which led to the failure of the bills which were applied for in 1828 and 1829. The Commissioners under the existing Act (1843) are—the Magistrates and Town Council, 19; Burgesses of Guild, 9; members of Incorporated Trades, 3—in all 31. No person can vote for or be elected a Commissioner who is not either a Burgess of Guild or a member of the Incorporated Trades. Each Burgess of Guild, not in receipt of aid from the Guildry Charitable Funds, is entitled to vote in the election of Burgess of Guild Commissioners; and Burgesses of Guild, qualified to be elected Commissioners, must stand rated in the tax-roll of the city, upon trade or business, to the extent of 2000*l.* or upwards, or be owners in their own right of at least 100 tons of shipping registered at, and belonging to, the port. In like manner, each member of the Incorporated Trades, not in receipt of aid from the Trades Charitable Funds, is entitled to vote in the election of Trades Commissioners; and members of the Incorporated Trades, qualified to be elected Commissioners, must stand rated in the said tax-roll, upon trade or business, to the extent of 1000*l.* or upwards, or be owners in their own right of at least 50 tons of shipping belonging to, and registered at, the port. One partner of any company carrying on trade as Burgesses of Guild within the city, and rated as above to the extent of 2000*l.*, is eligible to be a Commissioner; and for every additional sum of 2000*l.* one other partner is eligible. The same rule applies to companies carrying on business as members of the Incorporated Trades within the city—the qualifications being 1000*l.* each partner. The meetings of the Commissioners are held in the Town-hall. The reporters of the newspapers get notices of each meeting, and attend regularly. The present system appeared to work well, and to have the confidence of the public.

The Commissioner then asked for the minute-books, letter-books, &c., of the Harbour Board, in charge of Mr. Angus, which he examined and declared himself perfectly satisfied with them. He stated that at no port at which he had been had the returns to the queries transmitted by the Tidal Harbours Commission been so accurately and fully answered as at the port of Aberdeen, a circumstance for which the Commissioners were much indebted to the energy and industry of the harbour clerk, Mr. Angus.

Mr. Reid, Treasurer and Collector to the Harbour Board, was next examined. The first subject on which he gave evidence was the increase of the revenue of the port, which, he said, had doubled in the course of twenty years. The rate of increase, since 1810, he gave as follows:—

	£.	*s.*	*d.*
1810	7,214	11	8
1820	9,378	11	11
1830	12,347	6	1
1840	17,874	3	5
1845	23,760	8	7

The rates are levied upon goods and shipping, and, since the alteration of the rates by the existing

APPENDIX C.

ABERDEEN.

No. 187.
Evidence taken on the 26th Oct., 1846.

Act (1843), the revenue had greatly increased. There were no complaints against the system now in use, nor was it intended to raise the present rates, although, were it found necessary to do so, the Board had the power to raise them 25 per cent. His experience had led him to believe that the shipping would increase with increased accommodation. The harbour debt was the next subject. This amounted, in September 1845, to the sum of upwards of 186,676*l.*

COMMISSIONER.—Would you state when this debt commenced, and how increased?

Mr. REID gave the debt, at various periods, as follows:—

The debt for the year 1810	was £	29,000	0	0
„ „ 1829	„	112,090	0	0
„ „ 1843	„	172,411	0	0
„ „ 1845	„	186,676	5	0

The expenses of dredging, &c., are upwards of 1000*l.* a-year. The charge for maintaining the harbour lights is 335*l.*, and the revenue from light-dues, 308*l.* The trade of the port amounts to about 322,000 tons—the foreign being about 24,000 tons; and the coasting, 298,000 tons. The tonnage belonging to the port is about 45,000 tons. There are 207 sailing vessels belonging to the port, amounting to 38,062 tons, and 14 steamers, 6438 tons. One of the steamers is of 1100 tons burden.

Some questions were then put relative to the expense incurred in obtaining the various Acts required for the improvement of the harbour.

Mr. REID gave the history of these Acts. The Act of 1810, he said, had cost 1498*l.*, in consequence of opposition, many parties objecting to it on the ground that it raised the dues from 1*d.* to 3*d.* the barrel bulk. The Act of 1813, being merely supplemental to this Act, was unopposed. In 1828 an Act was applied for to continue the improvements, as only three years had to run of the term specified in the Act of 1810. This bill was much opposed, on the ground of a desire to add other members to the corporation in the management of the harbour. The bill was lost—expense, 1946*l.* Next year (1829) another bill was applied for and obtained. By this Act a new Harbour Board was constituted, and the term for completing the works limited to twelve years. Another bill was applied for in 1839, chiefly for the equalization of the dues, and met with much opposition.

Mr. ANGUS.—That measure was opposed, not as respected the dues alone, but on the ground that the improvements ought to be allowed to lie over for some time, in order that the surplus revenue might go to the liquidation of the harbour debt. In 1843 (the existing Act) there was much expense incurred in the necessary preparation for forwarding the bill then obtained. Much information had to be procured from other ports, and very many meetings were held with shipowners, merchants, manufacturers, traders, and others, for adjusting and regulating the rates of dues both on goods and shipping, and long and valuable reports were drawn up and published, for which the public were chiefly indebted to the late Mr. Thomas Bannerman.

COMMISSIONER.—Yes; and the documents were very ably prepared. There ought always to be a sufficient number of shipowners in the Board.

Mr. ANGUS.—The number of elected commissioners by the Act of 1829 was six, by the existing Act of 1843 it is twelve, and amongst these are merchants, manufacturers, shipowners, and others engaged in trade and commerce.

COMMISSIONER.—With regard to parliamentary expenses, attorneys' fees, the payment of witnesses, and such like—they have a chance of being done away with in similar cases in future, for which you will have to thank your countryman, Mr. Hume, M.P. It is proposed, instead of receiving evidence before a parliamentary committee, to appoint a commission to take evidence on the spot, which will be much less expensive, and it is hoped will serve the object intended fully as well.

Mr. REID then proceeded with his evidence.—He stated the various heads of expenditure, as shown in the printed accounts. There was, he said, no omission or neglect in the collecting of the dues, as he had a number of collectors under him. The dues can be raised 25 per cent., should the Special Commissioners sanction the increase. Of the shipping trading to the port he gave the following statement:—In 1820 the number of arrivals was 1500; the tonnage, 140,507—vessels employed in the foreign trade, 81; 10,654 tons—vessels employed in the coasting trade, 1419; 129,853 tons. In 1840 the arrivals were 2246; 248,598 tons. In 1845 the arrivals were 2234 vessels; 285,490 tons—employed in the foreign trade, 164 vessels; 21,146 tons—coasting, 2070; 264,344 tons—sailings, 2239; 287,000 tons. There have been no complaints given in on the subject either of dues or harbour accommodation. There had formerly been on the score of lying aground; and he had known of merchants, on that account, being obliged to give higher freights to vessels to come to this port. This complaint would be removed when the dock should be completed.

Mr. ABERNETHY, Resident Engineer, examined.—He gave a brief history of the improvements of Aberdeen Harbour, commencing in 1773, when there was no North Pier. At that period there was a bar nearly dry at low water, caused by the influence of easterly storms choking up the embouchure of the river, when it was in a low state, from want of a sufficiently powerful and well-directed outgoing current. Mr. Smeaton, in 1770, projected the North Pier, in doing which he had a two-fold object in view—first, to protect the entrance from being choked up with sand, particularly in north-easterly gales; and second, to carry the deposit brought down by the river more within the influence of the tidal current, which would sweep it round the Girdleness Point. The pier, one thousand feet in length, so far answered its purpose, as a greater depth of water was obtained. In 1797 Mr. Rennie was called in, and projected various improvements, which were not carried into effect; but it is worthy of remark that Mr. Rennie projected a wet dock, although in a different site to the one now being carried into execution, showing that even at that early period the necessity of a wet dock was apparent to this great engineer. In 1802 Mr. Telford was first consulted; and in 1810 a Bill was procured for improvements according to his plan—namely, the extension of the North Pier, the constructing of a wet dock, diversion of the river Dee, and formation of a Spillwater Channel. In an engineering point of view, could not see the necessity of this latter work—the present river channel was quite sufficient to contain its waters. All these improvements were carried out in 1829, except the formation of a wet dock—the quay walls alone being built. In 1840 he became engineer; had his attention first directed to a proposed cast-iron light-house on the end of the North Pier; disapproved of it, and recommended the substitution of leading lights, which were erected. Had next turned his attention to sand-banks at the harbour entrance. To remove these had recommended the removal of Abercrombie's jetty, and the building of a retaining wall, and embanking from Point Law westward. Was

APPENDIX C.

ABERDEEN.

No. 187.
Evidence taken on the 26th Oct., 1846.

not permitted to carry out first suggestion; the second was carried out, and found so far effective, that the steamers, which were constantly grounding and lying there whole tides, had never done so since the execution of this work. Had widened the harbour to a great extent; removed all the old pauls or warping-posts, surrounded with large masses of stone; and the stuff dredged out, on his recommendation, had been deposited in the gaps of the bents, or sand-hills, between the links and the sea, protecting them from the encroachments of the wind and sea, and forming valuable ground. Mr. Abernethy strongly, at an early period, recommended the widening and deepening of the river Dee, so as to have a uniform depth of channel from the Chain Bridge to its mouth. The only objection to this at the time was, the interference with the rights of the salmon-fishers. The alteration of the course of the river, he urged, would be productive of great advantages. There is, immediately beneath the Suspension Bridge, a very deep pool, and contiguous to it outward an extensive shallow, so that during speats great quantities of gravel are brought down, causing the formation of banks at the river mouth. The want of uniformity in the beds of rivers was one great cause of bars. The river, if diverted and improved, would tend much to deepen the entrance channel. Did not think the harbour entrance depended altogether on tidal or backwater—a good deal to the natural discharge of the river. Some estuaries did, as that of the river "Ythan," which was mainly kept open by backwater, the natural discharge being very small. The tide flows two miles up the Dee. As engineer of the Bill, 1843, he projected the following works:—The formation of a paved slope south side of harbour entrance; extension of Point Law; formation of a dock in tidal harbour, having an area of thirty-four acres, and a main sewer or culvert for the drainage of the city. Of these were executed—the large coffer-dam for lock; sewer, with a small exception, under the canal; masonry of lock more than half completed; the Provost Blaikie's Quay up to Return Walls; the Upper Dock nearly excavated. Waterloo Quay, which was not water-tight nor sufficiently deep founded, is to be rebuilt. Did not propose to under-pin any old walls; the depth alongside of them to be as at present—at the new quays nineteen feet ordinary springs. One thousand feet of new wharfage would be completed in April. In the end of 1848, the dock, he anticipated, would be ready for the reception of vessels. The portion of back or tidal water locked in would be considerable—that of the whole harbour was 28,000,000 cubic feet; this would be compensated for by the diversion of the river Dee giving full effect to the outgoing current, the increased area of the new channel, and proposed tidal basin. He considered the rights of the salmon-fishers a great obstacle to the improvement of the harbour.

Mr. ANGUS stated, in answer to a question from the Commissioner, that the Council had at one time possessed the property of the Dee fisheries in that portion of the river alluded to, but had sold them upwards of a century ago, reserving the feu-duties in their own hands.

Mr. ABERNETHY then proceeded with his evidence on the subject of the Harbour Improvements. He was perfectly satisfied with the sufficiency of the works at present in progress. They were founded on sandy clay, having gravel beneath. Nothing had given way since their commencement. They were built of Aberdeen granite, greenstone from North Queensferry, and freestone from Dundee. He had heard repeated complaints regarding the uneven bottom of the present harbour; but more from the steam-companies, whose vessels had fixed berths dredged to receive them. These complaints would be obviated by the wet-dock. The dock would contain 34 acres; the lock 60 feet wide, 250 feet long between the gates; 21 feet water on the sill; the single entrance 70 feet wide. The gates were to be chiefly of iron, on the principle of a caisson. The lock would take generally four minutes in filling. The time of passing depended on the activity of the persons employed; probably ten minutes would be required. In order to avoid loss of time and water in locking in, small vessels had an intermediate pair of gates in the lock, which removed any objections on that point. The tidal harbour, by the erection of the slope on the south side of the entrance, would be less subject to the swell of the sea in gales than at present. The harbour was rendered more unquiet than it might be by the rebound of the waves from the south pier against the North Capstan Point, which latter erection ought to be removed.

In reply to a question from the Commissioner, Mr. ABERNETHY pointed out the plan of a breakwater proposed by him, shown on a model of the harbour. This breakwater, he urged, would be of great advantage—20 acres at least of good and safe anchorage, with a depth of 25 feet, low-water, ordinary spring-tides, would be obtained within it. It would form an excellent harbour of refuge in itself, and effectually protect the present harbour entrance. The *Newcastle* schooner rode at anchor within the space proposed in a gale for twenty-four hours, and sank at her moorings. Such was the quality of holding-ground. A number of vessels had been lost near the mouth of the harbour that would have been saved had the proposed breakwater existed. They would get stone for the erection of the work close at hand. He had made a probable estimate of the expense of the undertaking: it was more than the harbour-funds would at present afford, whatever they might do hereafter. He thought the work ought to be a national undertaking, as it would be attended with national advantages.

COMMISSIONER.—Since you have got stones so near, why go to Queensferry for greenstone?

Mr. ABERNETHY.—The stones there are not of a nature or size that would suit the dock; the stones that could be procured there would do for a breakwater, but not for the lock. Had caused tidal observations to be made for some time night and day; and, for his own information, was making them just now at the coffer-dam, such as would enable him to furnish information to the Admiralty for tide-tables. The harbour was deepened generally at least two feet. There were fixed tidal indices: fifteen feet on these was high water, ordinary springs, which was the datum he had observed in all his surveys and plans.

Mr. GIBB, Civil Engineer, in giving his evidence, stated that the foundation of the north pier was of rubble-stone, thrown down, not placed. The foundations were rubble, with a casing of ashlar-work. The pier point gave way several times, and was only found to be secure after the erection of the present horseshoe point, which was designed by Mr. Telford. The stones are clamped together by strong iron bars, and, instead of any of those at the point being carried away, it was seen that any stones lying in the vicinity of the point had a tendency to move towards it. The passage along the north pier might be deepened to the extent of three or four feet, but he thought, if such were to be done, the pier ought to receive some protection. He approved of the breakwater proposed by Mr. Abernethy. The proposed sloping wall on the south side might be of advantage, as the rebound of the sea from the north pier was considerable, but it would require a slope of 1 in 15 to allow the water to expend itself properly. It would be desirable to remove the north capstan point. The jetty was erected both for a capstan and for stilling the water, and had been partly removed already. He believed it would be found convenient for ships, in passing out or in, to have it removed. The proposed diversion of the

Appendix C.
Aberdeen.
No. 187.
Evidence taken on the 26th Oct., 1846.

Dee would be very advantageous, and he believed the obstruction caused by the rights of the salmon-fishers to the improvement of the harbour, ought, if possible, to be removed by the purchase by the town of these rights. The land where the river runs at present would be of considerable value—as the Inches have been—to the Harbour Commissioners. The river would be better adapted to keeping the mouth of the harbour clear, and, at the same time, it would give more tidal space.

Mr. Torrie, on having a question put to him as a Harbour Commissioner, turned up, in a volume of evidence on matters relating to the harbour, a statement in which the sum that would be requisite to purchase the rights of the salmon-fishers was set down at between 70,000*l.* and 80,000*l.*

Mr. Alex. Hector, salmon-fisher, was next examined. He said that the fishings would cost less than the half of the sum mentioned by Mr. Torrie. Fishings are in general let for fourteen or seventeen years' purchase. Those in question are worth about 2000*l.* per annum; and would, therefore, be purchaseable for about 20,000*l.* He did not think that the diversion of the Dee would be injurious to the salmon-fishings. On the contrary, he was of opinion that, if any difference, the river would become a greater resort for fish. Neither would the extension of a pier, nor the erection of a breakwater, be injurious to the fishing. They would greatly improve the fishings at the mouth of the harbour, as they would afford additional means of fastening the nets, which were at present much wanted.

Mr. John Hector corroborated several points of the above evidence.

Mr. Morison, captain pilot, next gave evidence. On the bar, at the mouth of the harbour, he said, the channel had been deepened three feet since he knew it. There was now twenty-one feet and a half upon it at spring tides. In reference to the pilots, he said there were forty at this port. They are examined by the Shipmasters' Society. Most of them were fishermen; few of them seamen; although, in his opinion, seamen ought to receive the preference. They are paid by the vessels that they bring into port; and every vessel must take a pilot inwards. Still their remuneration is but small, owing to the competition among them. He has charge of the tidal light, which he kindles at half tide.

Commissioner.—Do you not think it unsafe to dispense with a tide-gauge? Might not the quantity of water be insufficient, at particular times, during the prevalence of strong easterly winds, for the safe passage of vessels into the port?

Mr. Morison did not think so. He has a tide-gauge, but knows the quantity of water in the harbour sufficiently without it; and if the state of the weather be such as might render it dangerous for a vessel to take the port, the light is not hoisted. Several vessels had been lost while taking the port, that he believed would have been saved by a breakwater. Mr. Morison's evidence on the roughness of the water in the harbour corroborated the evidence previously given on that subject.

Mr. Morrison, late master of the City of Aberdeen steamer, stated that he had seen people walk across the bar at the mouth of the harbour. This bar was now almost, if not altogether, removed. In his opinion the only safe lights for steamers should be on the bowsprit end and mast-head, in the the line of keel; this was far preferable to lights on the paddle-boxes.

Dr. M'Gillivray, of Marischal College, was the next examined. Having given in written answers to a list of queries that he, along with a number of others, had received, had little more to say. He stated that the observatory at Marischal College had been for some time not in use. He thought that it would be practical to drop a time-ball on the top of Marischal College, for the benefit of the shipping, but there was neither an astronomer nor meteorologist in the place at present as far as he knew—Dr. Fleming, of King's College, having been the only one, that he was aware of, who devoted much attention to such subjects, and he had now removed to Edinburgh.

Mr. Berry, nautical-instrument maker, on giving his evidence next, said that he was in the way of regulating the chronometers belonging to vessels in this port, which he did at Marischal College, where every facility was kindly allowed him by Dr. Cruickshank. There are now chronometers on board forty vessels belonging to Aberdeen, and there is every chance of their becoming more extensively used, as their great importance is now apparent to all shipmasters. He agreed with Dr. M'Gillivray that a time-ball on Marischal College would be of great advantage to the shipping. Had always a stock of chronometers on hand for the supply of vessels.

The Commissioner, at the conclusion, stated that at no place where the Commission had attended had the evidence been more complete and satisfactory. He congratulated the Commissioners on the manner in which the business of the harbour was conducted in all its departments. Mr. Angus's minutes of proceedings were complete. The books in the charge of Mr. Reid, the treasurer, were kept in a correct and distinct manner, while the ability and energy of Mr. Abernethy, the engineer, were fully evinced by the model and plans before the meeting, and the manner in which he conducted the very important improvements at present in progress.

Mr. Hadden, shoremaster, expressed, on the part of the Commissioners, the pleasure which it must afford them to hear such testimony borne to the excellence of the manner in which the affairs of the port were conducted. He begged to say one word on the proposed diversion of the course of the Dee. This alteration would be of very great importance. They would gain upwards of 80 acres of ground, which could be made the source of considerable revenue, while, as had been shown by the evidence, it would tend better to keep the mouth of the harbour clear of obstruction, and would afford more tidal space, and room for additional vessels in future.

The meeting then adjourned.

No. 188.

Return to Order of the House of Commons of August 9, 1844.

No. 188.
Return to Order of the House of Commons from the Harbour of Aberdeen.

Sir,

Aberdeen, March 27, 1845.

In compliance with your letter, dated Whitehall, 1st February last, I have now got prepared and send you enclosed copies of the maps and reports made by engineers and others respecting the Harbour of Aberdeen, viz.—

1st. Report and Plan by John Smeaton, Esq., Civil Engineer, respecting the Harbour of Aberdeen 1770

2nd. Letter from John Rennie, Civil Engineer to the magistrates of Aberdeen; also plan of proposed improvements 1797

3rd. Report and Plan by Thomas Telford, Esq., on the proposed improvements of the harbour . 1802

APPENDIX C.

ABERDEEN.

No. 188.

Return to Order of the House of Commons from the Harbour of Aberdeen.

4th. Reports and Plan by James Walker, Esq., Civil Engineer, on the harbour and proposed docks 1838

5th. Reports by the Committee, consisting of the harbour trustees and gentlemen appointed at a public meeting held 18th June, 1842. Also various plans of proposed improvements.

The titles of the various Acts of Parliament or charters under which the Commissioners have acted and do act, are as follows, viz.—

1st. Charter of King Charles I. to the burgh of Aberdeen 1638

2nd. An Act 13 Geo. III. cap. 29, intituled "An Act for deepening, cleansing, and making more commodious the Harbour of Aberdeen; for erecting new piers and quays therein; and for regulating ships and vessels trading into and going out of the said harbour" . . . 1773

3rd. An Act 35 Geo. III. cap. 41, intituled "An Act to continue the term, and alter and enlarge the powers of an Act made in the thirteenth year of the reign of his present Majesty, intituled 'An Act for deepening, cleansing, and making more commodious the Harbour of Aberdeen; for erecting new quays and piers therein; and for regulating ships and vessels trading into and going out of the said harbour'" 1795

4th. An Act 37 Geo. III. cap. 101, intituled "An Act for enlarging and improving the Harbour of Aberdeen, for building new quays, wharfs, and docks, and for making new roads and passages and widening others leading to and from the said harbour" 1797

5th. An Act 50 Geo. III. cap. 70, intituled "An Act to amend several Acts of the 13th, 35th, and 37th years of his present Majesty, for deepening and making more commodious the Harbour of Aberdeen" 1810

6th. An Act 53 Geo. III. cap. 137, intituled "An Act for the further improvement of the Harbour of Aberdeen" 1813

7th. An Act 10 Geo. IV. cap. 34, intituled "An Act for the improvement of the Harbour of Aberdeen" 1829

8th. An Act 6 & 7 Vic. cap. 72, intituled "An Act for improving and maintaining the Harbour of Aberdeen:" 1843, being the existing Act.

I am, &c.,

Hon. H. Manners Sutton.

ALEXANDER REID.

No. 189.

Report of JOHN SMEATON, Esq., C.E, F.R.S., *upon the Harbour of the City of Aberdeen.*

No. 189.

Smeaton, on improving the Harbour.

Austhorpe, February 19, 1770.

THE principal complaint attending this harbour is the difficulty of entry, occasioned by a bar a little without the harbour mouth; and a shifting bed of sand, gravel, and shingle on the north side of the entry, which by the action of the seas, when the wind is in the north-easterly quarter, drives in to the main channel, choking it up in different degrees, according to the degree of violence of the sea, the state of the tides, and of the land speats, floods, or freshes in the river Dee, which here falls into the sea.

When I was there, which was in the month of August, 1769, the entry was then said to be in a good state; and on sounding it, upon the 7th of that month, which was the 6th day after the new moon, and consequently the tides in a mean state between spring and neap, I found full 4 feet of water upon the bar at low water, and at high water the same day full 14 feet; but it is said that the ordinary spring tides make much about the same depth upon the bar at high water, and at low water the bar is left with only the run of the river over it.

The neap tides, it is said, usually make 10 feet water upon the bar; but this is to be understood, I suppose, at such times as the entry is in a good state.

On sounding at low water, I found the body of the bar to be composed of loose stones of different sizes, and the whole intermixed and compacted together with gravel; over which was a layer of sand from six inches to a foot in thickness, which after great land freshes is said to be quite swept away, and the stones and gravel left bare, which is its best state.

The bar is but of short extent, and both within and without we quickly get more water by three feet.

Without the bar the water gradually deepens, and forms a very good road for ships to ride at low water, and is naturally protected from all winds except the north-easterly and easterly, which blow right into the harbour's mouth; so that, were there a little more depth of water over the bar, and this certain, this harbour would be capable of affording very good protection to merchant ships trading into those seas.

The cause of the annoyance of the harbour's mouth appears to me to be this:—The whole coast, which stretches away northerly, is apparently for miles a flat and sandy shore; and I suppose from the harbour of Aberdeen till it meets with the point of Buchan-ness, which is at the distance of seven leagues, continues of the same kind; consequently the wind at N.E, acting obliquely upon it, brings the sand and gravel therewith intermixed coastwise towards the south; and as the coast from the south side of the entry of this harbour stretches away nearly east for about three-fourths of a mile, those sands would naturally be deposited in the angle of the coast formed at the harbour's mouth, did not the necessity of the land waters of the river Dee, in finding a passage to the sea, force themselves a vent, and which they maintain more or less clear according as the circumstances of winds, tides, and freshes balance one against another.

A hard gale of wind at N.E., as already mentioned, gradually brings the sand and gravel coastwise southward, and puts in agitation that already lodged in the bank on the north side of the harbour's mouth, at the same time forcing it into the entry; and if at that time it happens to be spring tide, and little fresh water in the river, a strong tide of flood, being the consequence, greatly co-operates with the wind and seas in carrying a great quantity of sand and gravel into the channel of the river; and the fresh water in the river being supposed then very short, the reflux will be very languid; and being counteracted by the impetus of the sea, it cannot return; and a continuance of weather and circumstances of this kind will put the mouth of the harbour into the worst state, in which it must necessarily remain till by a contrary disposition of circumstances a contrary effect is produced.

On the other hand, a continuance of great land floods, either at spring or neap tides, accompanied

Appendix C.

Aberdeen.

No. 189.
Smeaton, on improving the Harbour.

either with off-shore winds or moderate ones at N.E., gives the greatest advantage in scouring ou the sand and gravel from about the harbour's mouth, carrying it out into the road, from whence by degrees it gets round the point of Girdleness.

And if towards the close of the work there happen, along with a strong land fresh, low spring ebbs, which give the current the greatest fall to sea, and at the same time run bare over the bar, with a moderate wind at N.E., which will give the sand some agitation without much impetus,—under these circumstances the strong body of the bar will be run clear of the sand, and the harbour' mouth will be put into its best state, and so will remain till the contrary causes produce, as before the contrary effects: and in this state of fluctuation must the entry of the harbour of Aberdeen ever remain till something is done to counteract the effects of that arrangement of circumstances whose natural tendency is to do harm.

The only means by which I can see this is likely to be effected is by the erection of a north pier, which will directly tend to the cure of the evil complained of, for it will not only keep the land freshes more confined in a body till they come into deeper water, but, what is of more consequence, it will in a great measure prevent the sand and gravel from being driven in. It will not indeed stop the continual driving of the matter coastwise from the north, but after the back or outside of the pier is filled up with sand, &c., to a certain degree, it will then go round the pier head, and by the superior action of middling freshes and spring ebbs will be kept in deeper water, and so get round the point of Girdleness without first getting into the harbour's mouth, or at least not to that degree as to obstruct the navigation in and out. By this means, the bar will not only be kept clear down to the stone bed, but, by lifting the larger sort of stones by art, the remaining gravel will wash out into deeper water, so as to make, as it may reasonably be expected, full two feet more water than there is now in its best state.

I can see no objection to putting this work into immediate execution, save the expense of it. To reduce this as much as possible, I have endeavoured to propose such a construction as, consistently with that solidity and permanency that a work of this kind ought to have, shall consist of the smallest quantity of materials and workmanship that I can think fit; and as the materials which nature furnishes here are of the best kind for the purpose, and arise near the place, I am in hopes that they will be raised and put together considerably cheaper than I have supposed in my estimate; which, for that reason, I desire may be considered in no other light than a form or blank, comprehending species and quantities; for as my stay in Aberdeen was obliged to be so short, the necessary examinations immediately relating to the harbour prevented my entering into those inquiries which tended only to acquaint myself with the price and value of labour and materials.

I therefore can only fill up the blanks by comparison with what has been done at other places less advantageously situated with respect to materials, and perhaps that of labour also. In order therefore to come at a real estimate, suited to the place, I must beg leave to refer myself to the inquiries of the magistrates concerning prices, or to a committee deputed by them for that purpose, and which, from their particular knowledge of the country and of the workmen, will, I apprehend, be done to more advantage than I could have done myself without a longer stay than my other avocations could possibly admit of. One thing, however, I must beg leave to suggest—that though what I now offer is, as I apprehend, the complete thing, which I expect to answer in the best manner, yet I am of opinion it will be found, if the pier is not carried out so far by 200 feet, that it will, in a great measure, relieve the present annoyances,—nay, that it will be of singular service if carried out but just beyond the present pier, on the south side of the entry, in which case it will be shortened by 350 feet. In the former case the expense will be reduced, according to my estimate, by 2028*l.*, and in the latter by 3549*l.*; and as the work ought to be begun from Sandness Point, where it is easiest and cheapest to be done, by this means the workmen will gradually learn the way of doing it to the best advantage, and will probably be able to contract for the more expensive part upon better terms than would seem to them feasible at the beginning; and as the work advances, the benefit and effect will be seen, so that it needs not be carried further out than by experience shall be proved necessary.

I come now to the improvements that may be made in the internal part of the harbour; and here I cannot but lament that the course of the river is distracted by so many channels, and covers so great a breadth of ground at high water; which want of confinement is not only detrimental to the procuring of a deep channel at the harbour's mouth, but within the harbour also; and it is particularly disadvantageous, that the main current of the river does not sweep the face of the town's quay;—this I should, without any hesitation, advise to be done by art, were it not for the fishing properties upon the main channel; but as I must suppose them irrevocably established, it remains to point out what is the best that can now be done, the fishings remaining as they are.

I observe that within the point of Sandness there is nearly the same water as over the bar, till the main river channel and navigation channel divide; which part of the river is marked in the plan as the Stell fishing.

In this part of the river, which is land-locked from all winds, vessels that will bear the ground and whose draft of water is such as not to go farther up, may safely deliver their cargoes, or shelter themselves when they come in by way of refuge: but after the aforesaid division the navigation channel becomes immediately shallow, carrying however 10 feet water till we arrive above the new pier, where opposite the ropery and dockyard it falls a little shallower to 9 feet 4; from thence it holds 9½ feet and 10 feet, till, meeting with the town's pier or quay, it again breaks into two channels, viz. that which stretches along the face of the pier, and that which is called the Blacky Pool.

The navigation channel by the pier side, from the aforesaid division, falls off at first to 9, then to 8, and gradually to 7 feet water.

The desirable improvement pointed out to me, and which seems of great consequence to the trade of the city, is to deepen the navigation channel quite away from the new pier to the west end of the town's pier or quay.

I observed, when there, that little or none of the current water of the river Dee in its common state at low water goes down either the channel by the face of the pier or the Blacky Pool; all the outlets from the main stream that might be likely to take this course being barricaded by stone dykes raised from two to three feet, or thereabouts, above the ordinary surface of the Dee's water; so that nothing worth notice, till the water is swelled above those dykes, can go down the above-mentioned channels save the water of two small burns which empty themselves by the navigation channel. With these helps, however, but principally by the currency that passes through it and the Blacky Pool, in time of such speats as overflow the aforesaid dykes, the navigation channel is kept open.

No. 189.
Smeaton, on improving the Harbour.

It has been proposed to bank in the low grounds lying west of the old pier, so as to pen in the spring tides, and at that place to erect a sluice to be drawn at low water; and by making an artificial scour, to deepen the aforesaid navigation channel.

Great effects are capable of being produced by the operation and judicious management of sluices, in situations adapted thereto, that is, where there is a great command of fresh water, or a considerable declivity in the part to be scoured. Here, the water to be pent in must be in a great measure tide water, which, as the embankation would in a great degree prevent all currency through it, would be subject to fill up the reservoir. And as the water would not be considerable in itself, and the length according to the navigation channel, nearly a mile, upon 4 feet only of descent at low water, I fear, these circumstances considered, the effect would not be found answerable to expectation. On the other hand, the embankation preventing the speats which overflow the dykes from getting in at the head of the navigation channel, the principal natural agent would be prevented from operating, and which I should be sorry to lose. Were the long dyke, called in the plan the little dyke, broken down and removed, I make no doubt but in the course of a few years the main stream of the river Dee would make its passage by way of the Denburn into the navigation channel, and by degrees of itself produce the effect desired, and, with a little help, would do it in a very few years.

I state this, not upon any supposition that the little dyke is likely to be removed, but more strongly to show the use of such natural advantages as still remain. I do not suppose, however, that any use that can be made of the remaining advantages will, of themselves, greatly deepen the navigation channel; but this I suppose, that after it is made deeper by art, those natural advantages may be so applied as to keep it equally clean at a greater depth, as they now do at a lesser.

The whole channel, from the new pier to the town's pier, does not need a great deal to make it fall 10 feet water, and it may be very successfully deepened by a ballast-lighter constructed like those used upon the river Thames for getting ballast for the ships.

Those lighters work by direction of the Trinity-House upon such shoals as are most obnoxious to the navigation of that river; and all the ships of that port are obliged to take their ballast from them at a certain price.

Perhaps much ballast is not taken out from the port of Aberdeen; but such as it is may be supplied by the lighter, in aid, as far as it goes, of the expense of raising it.

The channel, for the whole length of the pier or quay, I would propose to be deepened by the mattock and spade at low water; which deepening being done 2 feet at a mean will give 10 feet water to the middle of the pier, where there is now but 7 feet 6 inches. And this being done to a breadth of 60 feet will admit of two vessels to lie abreast, with sufficient passage. This work will be attended with no extraordinary expense, in proportion to the utility thereof; and which will endure several years before the state of the channel will return to what it now is; yet it would undoubtedly return by degrees to the same state, unless some counterbalance be applied to prevent it. What I would recommend, therefore, for this purpose is as follows:—

To erect a strong stone dyke, beginning at the head of the Inch Dyke, in the direction of the single-dotted line, to the beacon upon the Trinity Inch; or if it should any wise happen to interfere with the Raik fishing, to carry it from a lower part of the Inch Dyke to the said beacon, according to the direction of the double-dotted line: this dyke to be made so as to rise above and keep in the water of the Highland floods at half ebb of the tide; and to be made firm, so that the current may, in great land floods, at high water, go over it without hurting it; and by this means the greatest part of the water that in time of speats flows over the present dykes, making its way partly by the Blacky Pool, partly over the surface of the higher lands, and partly by the navigation channel along the face of the pier, will all be constrained to go, through the channel alongside the pier, altogether, and therefore will be as well enabled to keep clear that channel at 10 feet deep, as the present channel joined to Blacky Pool is to keep it at that mean depth, from their junction to the junction of the main river at the Stell fishing. As these operations are plain and simple, and will be attended with no considerable expense, I earnestly recommend their execution.

It is also very practicable, in like manner, to join the old pier, by a dyke across the Trinity Inch, to the elbow of the river a little above the Inch Dyke, according to the single-dotted line, A. B.; and also by putting sluices upon the opening between the north end of the old pier and the west end of the town's pier or quay, to pen in the tides in order to make artificial scours; but as the building and maintenance of sluices would be expensive, if made so capacious as not to be an impediment to the current and action of the land flood waters, as above mentioned, and would have no considerable effect unless the water were pent up higher than the present fishing dykes, the banks whereof, if so, would in a great measure prevent the flood waters going that way, it therefore appears that, since sluices of any kind are likely to prevent more good than they will do, the plain, natural, and simple method first described, of making a dyke according to the single-dotted line first mentioned, is the most eligible to be put in execution.

Upon the whole, I am of opinion, that the methods pointed out to be pursued, without and within, will remedy the complaints the harbour is subject to, as far as is above specified, and possibly in a still greater degree.

J. SMEATON.

No. 190.

Letter from JOHN RENNIE, Esq., F.R.S., *Civil Engineer to the Magistrates of Aberdeen, respecting improvements in the Harbour, with estimates.*

No. 190.
Rennie, on improving the Harbour.

Stamford-street, London, Jan. 27, 1797.

GENTLEMEN,

THE great benefits that have arisen from the erection of a north pier at the entrance of the harbour of Aberdeen, and the increased trade the city has acquired in consequence thereof, naturally stimulate every one to bestow that due tribute of praise to its projector, Mr. Smeaton, which so excellent a plan deserves; but while we do this we cannot but lament that so little attention has been paid to the depth of the foundation, on which the stability of the work so materially depends. It appears, from Mr. Smeaton's Report, that he expected an additional depth of two feet of water would be acquired over the bar by the erection of this pier; from which one would naturally have supposed that the foundation of the works would have been laid sufficiently deep to admit of this expected increase at the entrance, and indeed something more.

Appendix C.

Aberdeen.

No. 190.
Rennie, on improving the Harbour.

But unfortunately this has not been the case, for on examining the work I found that the depth of the channel is considerably greater than the foundation of the pier; and therefore, were it not for the footing and shoeing of stones that have been made round its base, the pier would most certainly have been carried away by the heavy north-easterly seas which, in storms, are to be resisted by it.

This shoeing or footing of stones has been extended from the jetty or breakwater (erected in the years 1789 and 1790, to prevent the inrun of the sea) quite round the head of the north pier and back again to the said beach on the north side; which shoeing is continually giving way from not being so deep or so judiciously executed as it ought to have been.

Before, therefore, I give my opinion concerning the general improvement of the harbour, I will suggest what appears to me the best method of securing it, and which ought to merit the earliest attention of the magistrates.

When the water on the bar was 4 feet the depth of water at the extremity of the shoeing was 3 feet, and on the north side of the pier-head 2 feet, which is considerably under the base of the shoeing, and, I have reason to believe, at least 2 feet deeper than the base of the pier.

To remedy this evil in the best way, it appears to me a set of shuting-tiles, 7 or 8 inches thick and about 10 or 12 feet long, should be driven into the bed of the sea, which is here a tough clay, at a distance of 10 or 12 feet from the pier, to the level of the present footing; and another set of these piles should be driven close by the base of the pier, each set having guide-sets bolted to them. These two sets of piles should be bound together by ties or sets laid from the outer guide-set to the inner, and strongly fixed to each other by iron staples and bolts. The present footing should then be taken out by degrees, and the space between the piles filled with square-dressed stones, about three feet long, set on end, they being as large at the tail as the head, and wedged between with wooden wedges and filled with rough lime-rubbish. If this is judiciously done, I have no doubt but the pier will be quite secure.

The harbour of Aberdeen is well guarded from the southerly winds by the projecting rocks, called the Point of Girdleness, and the only storms that have any material effect on it are those from the northward and north-east—to prevent which the North Pier was erected; hence, in point of safety, no kind of advantage whatsoever can be derived from the South Pier, but rather on the contrary: for when the waves strike on the North Pier Head and leap round it, they are resisted by the South Pier, and create an undulating motion, which is greater than if it were a flat shore, on which they might expend their fury and be dispended, instead of rebounding on the opposite side as they now do. Had this pier been removed before the jetty or breakwater was erected, I am of opinion the inrun of the sea would not have been so materially felt at the Town's Quay as it was; but the jetty or breakwater having so effectually removed this evil, I need say no more on the subject.

The only advantage that I can perceive to arise from the South Pier is (exclusive of supporting capstans for pulling in the ships in westerly winds) keeping together and directing the floods or speat waters with the reflowing tide against the bar, so as to keep it from accumulating and thereby preventing the sand or beach, which is brought along the coast from the north, from entering into the harbour; but its point or head should always be covered by the North Pier, which is scarcely sufficiently done at present.

And therefore, while the North Pier remains as it is now, the wooden head at the eastern extremity of the South Pier might as well be taken down, being nearly in a state of ruin, and the head finished with a bulwark of stone to about half the length of the present wooden head. This would leave a greater space of flat shore for the waves to disperse themselves upon, and make the entrance to the harbour more quiet; and whenever the North Pier is extended, which I have no doubt will be sooner or later the case, the South Pier may also be proportionally extended.

To prove the propriety of extending the North Pier, one need only examine the soundings in the place, from which it appears that immediately on passing the bar the depths increase, and they are already sufficient towards the jetty; therefore, were the length of the pier increased, a greater depth of water would be got over the bar.

I must likewise recommend the taking up of the loose stones that lie along the base of the pier, and repairing such parts as have given way; and indeed the loose stones should be taken up quite from the jetty to the bar, as they tend very much to retard the velocity of the speats, and in consequence the gradual improvements of the entrance.

The improvements of the interior harbour may be considered in two points of view:—First, those of which it is capable as a tide or dry harbour; and secondly, those of which it is capable as a wet or dock harbour. In respect to the former, considering the salmon-fishing as an important object, I can advise little if anything more than what Mr. Smeaton has done, and which, of course, ought to be carried into execution.

But whatever is done in this way can only be a partial business. I am convinced that no permanent and essential improvement can be made unless the waters of the Dee are to be subservient to the harbour.

From the soundings taken by me, and marked in the plan with red ink, it appears that when there were 12 feet 6 inches on the bar, there were then 9 feet 8 inches opposite the lime-sheds, and in some places between them and the Town Pier only 7 feet, and opposite Marischal-street 6 feet—the channel diminishing gradually from the lime-sheds to thence; whereas in the main channel of the river, opposite the little lane in point, there were then 17 feet water, and at the head of the island, 13 feet 5 inches. This evidently shows that, were the river turned down by the Town's Quay, and the channel properly contracted, a depth nearly equal to that on the bar would be obtained; and in proportion as the whole or a part of the river is turned along the channel, in proportion will be the advantages to be derived therefrom.

The first object therefore that would meet the attention of the magistrates for this plan is to purchase the whole rights of the fishermen; then, by opening a channel from the Little Inch Dyke to a little below the old pier at the shore brae, a part of the Dee may be made to go along the Town's Quay; and by employing proper persons to ballast out and loosen the mud, it would gradually become deeper, and the quantity of water taken from the Dee may be increased as wanted, when once the navigation channel is brought to a proper depth. I do not imagine it would be necessary constantly to have the whole of the waters of the Dee running through it—an occasional scouring would answer the purpose; but I apprehend a dam with draw-sluices would be requisite, that the water may be let down the new channel along the quay as might be wanted, which would be particularly useful in time of ice-floods. And it will be requisite to make a low dam, or perhaps a moveable stank, across the present channel, just sufficient to turn the water into the new channel when the sluices are drawn. This dam need not much exceed 2 feet or 2½ feet in height, as the new channel, being deeper, would naturally draw the water through it. But previous to this being done it will be necessary to rebuild the Town's Quay, and to lay the foundation much deeper than at present, for it is not quite so low as the bed of the channel; and in doing so it might be advanced 10 or 12 feet into the harbour, so as to enlarge the wharf or quay. That part of the quay next to the lime-sheds should be removed farther back, and it might be continued quite to the ship-builders' yard at the lower end of Footdee, if wanted, which will give at least 500 yards of additional quay-room, and form a general curve or sweep from the shore brae.

This wall or quay being set very near to the village of Footdee, and the ground being excavated along its face, will tend to increase the reservoir or basin of the harbour instead of diminishing it, and thereby increase the scour of the harbour's mouth. From this place the Commissioners of Police may have earth to bank up the road along the Denburn, which they may safely make close by the new channel. It may perhaps be necessary to erect some low jetties, with beacons, at a proper distance from the quay, say 50 or 60 yards, to keep the river-water into one channel. These jetties need not be expensive, as they have but little resistance to overcome.

Should these improvements be judiciously carried into execution, I do not hesitate to predict that Aberdeen will have as complete a tide-harbour as any place in Great Britain.

As to the second plan, namely, the wet docks, I must observe that few places are better situated in respect to the form of ground for wet docks than Aberdeen, but unfortunately the soil is as unfavourable; from every examination I could make there was nothing to be found between the new pier and the city but a small running sand full of water, at the depth of half tide.

Therefore whatever is to be done in the way of wet or dry docks, must be made at a very considerable expense. No place seems so well adapted for this purpose as the place whereon the present village of Footdee stands. The ground is low and would require but little expense in excavating, and the stuff that would come out of it would be fully sufficient to raise a margin round it for wharfs and warehouses. It would not be possible, at any reasonable expense, to excavate sufficiently to fill docks with water from the tide, because the ground, being an open sand, would admit such quantity of water while the works were executing, during the time of tide, that no reasonable expense would take it out.

It should, therefore, be done on a higher level, and supplied from other sources.

Fortunately, the proposed Aberdeenshire canal affords an opportunity of supplying it on very easy terms by water from the Don, or from the small streams that fall into it, by which the surface may be kept at any required height above the level of the tide. The highest tide during the time I was in Aberdeen, was 16 feet 4 inches on the index of the jetty. The ebb on the same day was 3 feet 6 inches on the index. On the 12th of September the highest rise was 12 feet 3 inches, and ebb 7 feet 1 inch, which I understand was one of the shortest they have.

I therefore propose that this ebb should be taken as the bottom of a wet dock; and supposing it to be made for 16 feet water, the surface of the dock will be 3 feet 6 inches above the present quay of Aberdeen; or should 14 feet water be judged sufficient, 1 foot 6 inches above the quay.

The ground is large enough to admit of a dock 500 yards in length, and 70 yards in width, covering a space of about 7½ statute acres, which would conveniently hold 60 vessels of about 300 tons burden each. This, I apprehend, would, in the present state of the trade of Aberdeen, be considerably too large; perhaps one half would do for the present—say 250 yards long, and 70 wide.

At the lower end of which, and of Footdee, there must be a lock for the entrance of ships from the tideway, having its site nearly as low as the bar, and if proper sluices are placed in its gates it may be turned, occasionally, into a backwater, for the purpose of scouring out the channel for ships to come into the dock.

At the north-east corner of the dock a good opportunity is afforded of making dry docks, which I propose to be done by a short cut or canal, about 50 yards long, with a drawbridge on it, terminating in a circular basin. Three dry docks may be made as represented in the plan, one of which would do for the present, the others may be made as the trade requires it.

From the bottom of those docks I propose a cast-iron pipe to be laid into the tideway, which with proper sluices will afford the means of emptying the docks of water without lowering that of the wet docks; and by having sluices in the gates of the dry docks themselves, the vessels may be floated at pleasure.

This plan affords an opportunity of making accommodation for the present trade, and of increasing it as the trade of the city increases, without any material inconvenience to the shipping. The dock, however, will require to be made in two lengths, with a communication, gates, and drawbridges, that the extension may take place without disturbing the trade of the other; were this not the case, or were the whole to be done at once, I should certainly prefer making it one dock instead of three.

Between the dock and fence wall, next the harbour, I have allowed 100 feet, but I think, if ever the plan be carried into execution, 50 feet more should be taken, in order that there may be sufficient quay-room, and for covered places for the cranes to work under.

Having now, gentlemen, described what appears to me the best method of improving the harbour of Aberdeen, under the two distinct heads of a tide or dry harbour, and of a dock or wet harbour—the expense of the former amounting to 23,320*l.* exclusive of the damage that will be done to the fishery and the purchase of some property in Footdee; the latter amounting to 36,620*l.* exclusive of the dry docks, canal, and circular basin, estimated at 16,697*l.*, and of the purchase of Footdee—it will now naturally be asked, what part of these plans I recommend being carried into execution.

No doubt the complete thing would be to execute a part of both plans, namely—to turn the course of the Dee along the Town's Quay, and to rebuild the same as far as the lime-sheds, and to confine the water by jetties, having a simple rubble wall, from the lime-sheds to the lower end of Footdee, instead of a quay; and to make the wet dock, No. 1, with the canal and circular basin, and one dry dock. Vessels might then use the tide part of the harbour or the wet dock, as circumstances might direct.

The expense of the works will be nearly as follows:—

Wet dock and lock	£20,360
Dry dock	9097
Rebuilding the quay and making a new channel	14,840
	£44,297

The above is exclusive of the purchase of property, which I apprehend will be pretty considerable.

APPENDIX C.

ABERDEEN.

No. 190.

Rennie, on improving the Harbour.

The expense, although great, I would fain hope would not exceed the town's funds; for, although it is more than they at present have the power of raising, yet, as the property cannot be purchased without an Act of Parliament, I have no doubt the inhabitants will agree to any reasonable additional harbour-dues being paid on the shipping, to enable the magistrates to carry the plan into execution, which will tend so greatly to increase the accommodation of the harbour, and, of consequence, the trade. And as the improvements will be gradual and progressive, revenues will arise out of them as soon as any part of them can be got into use, which will enable the magistrates to carry forward the others; and, therefore, the additional harbour-dues may not be of so long continuance as at first may be imagined; but should they even be so, the additional accommodation the trade must acquire will, I expect, much overbalance the extra harbour dues.

But should the inhabitants object to this, the wet dock, No. 1, may be carried into execution first, and the others proceeded with afterwards, as may be judged advisable.

In my report on the canal, I propose a considerable saving to the proprietors by a communication with a wet dock at the harbour; but as it may not be convenient for the magistrates to make the whole of this dock at once, it will be necessary to make a canal from the place where I recommended the wet dock, ultimately to be carried to the place where it is now recommended to end; this expense will not be considerable; but, little as it may be, it ought to be done at the city's expense, as the advantage they will gain by being supplied with water from the canal will be far greater than any expense this may cost.

Thus I have endeavoured to describe the general outlines of what appeared to me as the best method of improving the harbour of Aberdeen, both at its entrance and in the inner harbour; and I have had it particularly in view, planning so that the present trade should meet with little interruption while the works are under execution; and it will give me great pleasure should the magistrates approve of what I have recommended.

From the plans it will appear that the whole beach between the lower end of Footdee and the Town Pier is left as it is, where vessels may be built and repaired till the dry docks for repairing them are completed; after which it will remain for building ships as before.

I have, &c.,
JOHN RENNIE.

Estimate of the Expense of executing the Works proposed to improve the Harbour of Aberdeen, considering it as a Tide Harbour only.

	£
To embanking the sides of the river Dee, and securing them with stone, and making a low dam across, to turn the water along the town's quay	3150
To making a new channel from Little Inch to the old quay, nearly opposite to the shore brae, and securing the sides with stone, and making a dam with draw-sluices to let the water into, or keep it out of, the cut at pleasure	3960
To taking down and rebuilding the town's quay 6 feet deeper than the present one, and advanced at least 10 feet into the harbour, so as to enlarge the quay, and making a new channel for the river from the shore brae to opposite the Town Pier, with stone jetties to keep it in its place	7730
To building a new stone quay from the lime-sheds to the lower end of Footdee, and making a broad wharf along it	8480
	£23,320

Estimate of the Expense of making Wet Docks adjoining and communicating with the Harbour of Aberdeen.

To excavating for and building a lock at the lower end of Footdee, including coffer-dam and steam-engine for taking out the water	7100
To excavating for a wet dock, No. 1, and puddling round the walls with clay	6900
To building wharf-walls round ditto, including paving	6360
	£20,360

To excavating for wet dock, No. 2, the bottom of ditto, and puddling round the walls with clay	6900
Building wharf-walls round ditto, with paving	6360
To a communication between the docks, with double gates and a drawbridge across the passage	3000
	£16,260

Estimate of the Expense of making Dry or Graving Docks at the Harbour of Aberdeen.

To excavating for a canal and basin and lining ditto with clay, and also round the walls ..	1585
To building wharf-walls round ditto, with a drawbridge at the side of the wet dock ..	2532
To making a large graving dock	3980
To making two lesser ditto	6600
To paving round ditto where wanted	1000
	£15,697

JOHN RENNIE.

N.B.—It cannot be expected the above estimates are so exact as if detailed designs were made for the particular works to be executed; but when the Lord Provost and Magistrates shall have determined what parts of the plan they will carry into execution, proper drawings and estimates shall be made accordingly.

APPENDIX C.

ABERDEEN.

No. 191.

Telford, on improving the Harbour, and Estimate.

No. 191.

Report by THOMAS TELFORD, Esq., C.E., *on the Improvement of the Harbour of Aberdeen, and Estimate, April 29, 1802.*

AGREEABLE to instructions received from the Lord Provost, I have considered and drawn a plan of improvements which appear best calculated for perfecting the harbour and accommodating the trade of Aberdeen.

In forming this plan I have been guided chiefly by the following considerations :—

1st. To procure, at the least possible expense, the greatest extent of space, for wharfs and wet docks, or basins, where vessels may lie afloat at low water.

2nd. To avoid injuring the fisheries of the river Dee, on the south side, and occupying valuable ground on the north side of these wet docks and basins.

3rd. To acquire new ground for ship-building, rope-making, &c., upon what are now mud-banks, along the north side of the Dee, and to provide proper communications from this new ground to the city and wharfs on the north side of the wet docks.

4th. To place the locks and graving docks upon the ground which affords the best foundations, and where they will be most conveniently situated for admitting vessels.

5th. To provide for scouring the basins and entrances, the space between the north and south piers, and likewise the bar.

6th. To procure and preserve four feet more water than there is upon the bar at present, in order to admit frigates and large merchantmen at high water neap tides.

7th. To form a proper connexion between the canal and the wet docks.

Upon examining the situation of the borings upon the plan, with the description given of the nature of the strata they are made in, I perceive that the only place where hard clay is found above the level of low-water mark, is opposite the point where the course of the river Dee joins the backwater from the present harbour, where the boring is marked.

No. 1. The boring nearly opposite the Meikle Cairn, marked No. 9, proves that a bed of strong clay passes in that direction, although it appears to be at a greater depth at No. 9 than what it is at No. 1.

I consider it a fortunate circumstance that the clay is found in this particular spot; it ought, in my opinion, to determine the future improvements of the harbour, as by this means there is an opportunity of rendering it very capacious and commodious.

The leading features of the plan which I propose are, to place a tide lock in the middle of the channel which leads to the present quays, upon the place where the strong red clay affords a good foundation, and to excavate, to a sufficient width and depth, a space reaching from this lock to near the mouth of the Denburn. With the soil which must be removed in order to deepen this space, I would raise a bank along the north side of the river Dee, of a sufficient height to prevent the flood waters of that river from falling into the proposed wet docks, except by means of flood-gates, to be placed near the mouth of the Denburn. A street may be formed along this embankment. It will also be advisable to form a mound opposite to the lime-sheds, in order to divide the space into two basins, and to admit of a street leading from that on the north bank of the Dee to the city and wharfs on the north side of the wet docks.

In this mound there must be a passage for vessels, and a pair of gates to keep the water into the upper basin when it is let out of the lower basin.

The soil necessary to be excavated from the bottom of the basins might also be laid so as to form a considerable width of ground between the basons and the street along the north bank of the Dee; and this ground would be very valuable, as being well calculated for ship-building, rope-making, and various employments connected with shipping.

This would be the means of removing this sort of trades from the ground where they are now carried on, and it would in time become wharfs, warehouses, manufactories, and streets, with dwelling-houses for the workmen.

It will, probably, be necessary to form a small basin on the north side of the lower basin, to contain a few vessels when both the large basins are emptied of water; and the entrance to this small basin, in order to have the advantage of a clay foundation, should be made near to the tide lock.

A graving-dock may be constructed on each side of the tide lock. This situation will not only afford good foundations, but also tiers of considerable strength must, at any rate, be built on each side of the tide lock; the graving-docks may be formed within those masses of masonry, at a proportionably small expense.

At the top of the upper basin, near the mouth of the Denburn, a regulating weir must be made to take the flood waters of the Dee to scour the upper basin.

The lower basin, and the entrance to it, may be scoured by the water of the upper basin; and the space between the tiers and upon the bar may be scoured by means of the water of both basins and the water of the river Dee.

These basins will contain about 40 acres of water, and if this is applied at proper times it will prove a very powerful agent.

The ground between the basins and the river Dee may be formed to contain also about 40 acres, and its value will go a great way towards defraying the expense of the proposed improvements, the situations being so favourable for landing timber, hemp, &c., and for workshops and dwelling-houses for workmen.

According to the plan of improvements I have here proposed, the river Dee fisheries will not be in the least injured; the raising of the north bank, and cutting off a little at the Point Law, being all that is necessary to be done, except the lowering of the surface of the ground on the south side of the river, opposite the lime-kilns and upper basin. I think it advisable to have this ground lowered, to increase the space for backwater.

This would also afford materials for making the embankment along the north side of the river, and, if necessary, adding to the width of the ground for roperies, &c.

It is probable that by having the command of upwards of 40 acres of water in the basins, and by the improved mode of managing the backwater in the river Dee, the bar and entrance may be lowered; but in order to procure and preserve a sufficient depth of water on the bar and entrance at neap tides for admitting frigates and the largest merchantmen, it will be necessary to add about 100

Appendix C.

Aberdeen.

No. 191.
Telford, on improving the Harbour, and Estimate.

yards to the length of the north pier, and also to extend the south pier as shown on the plan. By doing this, and removing the gravel and mud from the bed of the entrance and bar, there would be about 4 feet more water gained; and the sand which is driven along the shore would either be lodged at the back of the north pier or carried quite round the point of Girdleness.

If the entrance is made lower it will be necessary to lay the foundations and sills of the tide lock so much deeper, and likewise to excavate one side of the lower basin to the same level as the bar. I understand the foundations of the north pier are not so low as the present surface of the ground between the piers by about 2 feet. The lowering of this surface 4 feet will remove it so much more under the level of the foundations, and the securing of these foundations becomes a serious and important object.

They may be secured, but the best mode cannot be pointed out until it is determined to what depth the surface of the ground between the piers is to be excavated.

The termination of the canal should be formed with two branches in order to communicate with both basins. If abundance of water can be procured for the canal, its fall at the locks may be made use of to work mills, machinery, or even cranes, on the wharfs.

The time and manner in which these improvements should be carried into execution depend chiefly upon the extent and command of the funds that can be applied to them. They may be accomplished gradually, or they may be done in a short time.

The expense may best be estimated on the spot; the means of improvement are simple, and, except extending and securing the piers, they would not be very costly when compared with the advantage which would be gained.

I have here added a very general estimate:—

Estimate.

80,000 cubic yards of soil to be excavated from the lower basin, at 6*d.*	£2000	
80,000 ditto, upper basin, at 6*d.*	2000	
Making the tide lock	4000	
Making two graving-docks	4000	
Making piers and gates to divide the basins	1500	
Making a regulating weir at the top	2500	
Making a new wharf-wall, in place of the present quay, 500 yards long, 4000 yards faced with the old stone and backed with brick or cheap rubble	2000	
		18,000
Add, to receive frigates and large merchantmen, at high water, neap tides.		
Add 100 yards to the north pier	£18,600	
Securing the foundations of the present pier	3600	
Extending the south pier	5000	
Deepening the space between the piers	3000	
Additional expense of tide lock	2000	
Deepening a part of the lower basin	1500	
		33,700
		£51,700

Thomas Telford.

No. 192.

Report by Messrs. Telford and Jessop, *on the Harbour of Aberdeen.*

No. 192.
Telford and Jessop, on the Harbour.

Edinburgh, October 14, 1805.

It has already been suggested that, as an object of considerable importance to the welfare of the town of Aberdeen, the adjacent country, and to the public, it would be very desirable to obtain a floating harbour, by forming an embankment between the present harbour and the channel of the river, with a lock for the entrance of ships, and the only doubtful point is the practicability of obtaining a proper foundation for such a lock.

From the trials of the ground, by means of boring, the result has hitherto been discouraging, except in two places marked No. 6 and 7 on the plan, and as the ground here appears to be sufficiently firm for building on if it should be found practicable to keep out the water during the execution. We have to recommend that in the first place those trials should be repeated, in order to ascertain the extent of ground of a similar quality; and on this being found sufficient to admit a lock of proper dimensions, that a well should be sunk for the purpose of knowing whether, at the depth of eight feet under low water, the quantity of water springing from the bottom would be or not be more than could be pumped out by means of a steam-engine.

If the experiment should prove favourable, it would, though not absolutely necessary, be further desirable to know whether, in addition to the lock, ground might be found for a single pair of gates as an entrance to a small tide basin, into which at neap tides a number of vessels might enter together, and be enclosed to pass at leisure into the large basin.

As at all events it is the intention to rebuild and extend the quays, according to or near to the line already described on the plan, this improvement would be perfectly compatible with the more extensive improvements above mentioned, and we annex to this Report the section of a wall which, in our opinion, is proper for the purpose. It may be built at the mean distance of about twenty feet from the present wharfs, so as to found it low enough for the bottom of the harbour when sufficiently deepened.

The specification of the workmanship is as follows:—

A. represents bearing piles of Scotch fir, of about ten feet in length or more if they should be easily driven, and seven or eight inches in diameter, at the distance of three feet from each other; and it is particularly necessary that they should be driven with an inclination, such as is shown in the section.

The engine most convenient for driving them will be a ram of from two to three hundred weight, hung to a pulley, which pulley is hung to a light triangle formed with two legs, with spikes in the feet of them to rest on a moveable plank. The third leg with a spike in the foot of it to be lighter and longer than the others, to support the two others to a proper inclination. To guide the ram in a proper direction, two small poles are loosely attached to the two legs of the triangle near the top by the noose of a small

APPENDIX C.

ABERDEEN.

No. 192.
Telford and Jessop, on the Harbour.

ord fixed to those legs; the bottom of those poles is also armed with spikes to stick into the ground, nd being set parallel to each other, with the ram between them, by moving the feet inward or outward, they will give the ram the same inclination in falling that the piles have; the ram is to have two nooses of cord affixed to it to slide on those piles.

B. is a cap-piece or plating of fir, 10 inches by 5 inches, fixed by tree-nails on the top of the bearing-piles.

C. are bearing-piles of 6 feet in length and 6 or 7 inches diameter, driven at the distance of 6 feet from each other.

D. Plates of three-inch plank laid on the top of them.

E. Four-inch plank piles of 10 feet in length driven close to each other, and spiked to the ground, plate B.

F. Three-inch planks of Scotch fir laid on the top of the ground plates, at the distance of 18 inches from each other.

G. Two-inch planks of Scotch fir of six feet in length, two of which are to be laid under the foundation of each counterfort.

H. Slips or boards of Scotch fir, 6 feet 6 inches in length and half an inch in thickness, two of which are to be laid in each counterfort, to give it a temporary bond with the walls until the mortar may have hardened.

I. Two slips of the same dimensions.

The wall is proposed to be four feet in thickness, both at bottom and top. And at the distance of 18 feet from each other, middle and middle, to annex to counterforts of three feet square.

The ashlar in the front of the walls to be 15 inches in the bed, and the bond stones, which should make one-eighth part of the superficial measurement, to be on an average 30 inches in bed or length.

The backing-stone to be from the granite quarries, as long and flat as conveniently can be got.

The mortar to be composed of good water, lime, and coarse sand, in the proportion of one bushel of unslaked lime to six bushels of sand, to be mixed in a dry state, and to pass together through a screen before being made into mortar.

As the deepening of the harbour is of the greatest importance towards its improvement, and the expense of this operation will depend much on the manner of performing it, we think it essentially advisable to recommend that it should be done by a machine to be worked by a steam-engine: we think it probable that such a machine would be capable of excavating from 400 to 800 tons in a day, if it should be thought expedient to provide a sufficient number of barges to convey it away.

The matter excavated may be laid on the inches towards forming an embankment which may become part of the more extensive improvement. Part of it may be conveyed by barges with hoppers or false bottoms so as to drop it on the lower grounds, and the other part must be wheeled from the barges by barrows.

We think that by the means above mentioned the expense will hardly exceed sixpence per cubic yard.

It may perhaps in fine weather be advisable to use this machine in deepening the bar of the harbour, as this, with hopper barges, may be done for threepence per cubic yard; at all events, in the future preservation of the harbour, such a machine will be a necessary appendage to it.

As the inches are formed of matter naturally deposited, it is not to be expected that additional matter laid thereon will be much liable to be removed, and especially when it shall be raised higher than the rise of land-floods. If in any part of the inches there should appear a tendency to remove the matter laid thereon, it may be defended by a facing of rubble stone, from time to time, as may appear to be necessary.

With the section of the wharf wall there is also a section of the common sewer, which we suppose to be of dimensions sufficient for the intention, and for a man to pass through it whenever it may be necessary in cleaning it.

W. JESSOP.
THOS. TELFORD.

No. 193.

Report of JAMES WALKER, Esq., C.E., *on the Harbour and proposed Docks of Aberdeen.*

Great George Street, Westminster, April, 1838.

No. 193.
Walker, on the Harbour and proposed Docks

A LETTER of 25th November, 1837, from James Milne, Esq., Lord Provost, and Chairman of the Board of Harbour Trustees, informed me that, "at their meeting on 27th September, the Harbour Trustees had resolved, before proceeding with any material operations connected with the harbour, to have it examined and surveyed by an engineer or engineers, from whom a report should be had of its present state, and what might be considered most proper to be done for its completion in a suitable manner in all its details; and that, at a subsequent meeting on 25th November, they had unanimously fixed upon me for the above duty;" the importance attached to which is fully appreciated by his Lordship in describing the harbour, "as the keystone to the prosperity of the city and the surrounding counties."

In consequence of the above appointment, I visited Aberdeen in January last, when I attended several meetings of the Trustees, heard the different remarks as to the wants of the port, and the opinions of several members of the Board, and also made the necessary surveys, in which I had the advantage of Mr. Gibb's attendance and information.

Since my return to London I have examined the various opinions and the plans of former engineers, which have, by desire of the Trustees, been sent to me by Mr. Gibb, and having given the same my best consideration, I have prepared a plan, which, in my opinion, will be the most suitable, upon the whole, for the purpose, and which I beg herewith to submit.

Although the Provost's letter, before quoted, embraces the harbour generally, I find the principal objects of inquiry are—

1st. The expediency of having a floating dock or docks, by enclosing part of the harbour within gates; and

2d. The extent and the best arrangement for accomplishing this object.

It is to these points, therefore, that my attention has been principally directed.

APPENDIX C.

ABERDEEN.

No. 193.
Walker, on the Harbour and proposed Docks.

General Expediency of Docks.

As respects the first question, viz. The general expediency of docks, there cannot be much difference of opinion. The number and the tonnage of ships engaged in foreign trade, belonging to the port, have been and still are increasing; the alteration in the mode of measuring for register tonnage, and the increasing despatch required to keep pace with the ships of other ports, have caused a sharper description of ships to be built. Add to this the introduction of steam-vessels, the machinery of which is more liable to injury by grounding than the vessels themselves, although these are of great size, and built as light as is consistent with safety. When I was at Aberdeen there were 15,000 tons of shipping in the harbour, some of the vessels being upwards of 400 tons burden. Now, as the depth in front of Waterloo Quay is only twelve feet at high water of neap tides, and fifteen at spring tides, such vessels are liable to a detention of two weeks by being neaped, as well as liable to be strained at low water, when, the small depth left under them being of no use in preventing damage, they cannot be said to be at all water-borne. The bottom is certainly soft, but even this frequently proves injurious to large vessels when they succeed smaller ones, and settle down upon the ridges or hollows which the others have left. I saw a large vessel nearly in this situation, and, from her greater width aft, she was with her keel upon the higher ground which the one before her had formed by her bed being narrow; in this position she would be kept until the following springs. This has been remedied for some of the large steamers, by piling in front of the quay and dredging out a dock for them, which they keep, and from which other vessels are generally excluded. From the different steamers' form being nearly the same, and from the greater depth of water, the straining is prevented, but the necessity for doing this in a particular case proves the general evil.

The greater convenience, and less expense, of unloading cargoes in docks where the vessel is always within two or three feet of being at the same level, are important, particularly where coal, the article of greatest tonnage, is landed, as in Aberdeen, at the quays, and where the labour and expense of hoisting at low water are so much greater. Probably calculations of this have been made; for, in coal alone, I am sure it would be serious, and of this the managers of the steam-packets particularly complain.

Were docks uncommon in the ports of Great Britain, Aberdeen would have its fair chance without them, for its natural advantages are superior to many; but when the ports near you, and those which your ships visit, have, or are preparing to have, docks (and few, if any, are not in either of these situations), it becomes more necessary to follow their example. Fine-built, heavy vessels cannot be expected to take freight at the same rate, if they are to be subject to the evils I have named by detention and grounding.

I fear I have said too much upon a subject which is so generally well known to most of the Trustees, and with the detail of which, as respects Aberdeen particularly, they must be acquainted from almost every-day experience.

Plans for Docks.

The second consideration, as to the particular plan of docks, supposing them desirable, is one in which the same unanimity cannot be expected to prevail. It is more difficult, and may be viewed in various ways, as respects extent, situation, and interference with the present harbour; and each person is apt, even where no interest operates, to prefer the view he has first taken, and, therefore, to press the arguments in its favour to the comparative neglect of what may be said against it.

Arguments against converting Harbour into Docks.

Taking the question as between the harbour and a conversion of a part of it into docks, it may be argued by those who prefer the harbour, that it has the advantage for steamers that always start at the same hour of the day, which is the case with the Leith steamers, and all that make short voyages. *Secondly*, That these vessels will not go within gates, and, as they take the greatest number of passengers, the inconvenience by it will be great if they have a distance to go to the vessel; that small vessels can *now* leave the harbour at half-flood, by the assistance of tugs, and, if the wind is fair, get a considerable way south with the flood tide before it is high water at sea; that they do not injure, by grounding, and that, on their arrival in the harbour, they can get to their berths long before high water; that, therefore, the dock, which will pass them only an hour or two before high water would, it is said, be less convenient for them than the harbour, in which they are at liberty so soon as there is water to float them. *Thirdly*, That the rise and fall of the tide, and the current in the harbour, prevent the water from freezing, which it will be liable to do in the docks, and the ice closing the dock-gates, or their being otherwise out of order, will cause detention to the vessels. *Fourthly*, That when the lock is so much out of order as to require repair in the foundation, and to be shut up for a time, all the vessels must be kept in the part of the harbour below the lock. *Fifthly*, That there will be a loss of time in locking in or out; that despatch is every day becoming more important; and that, in neap tides, the time when a ship of considerable burden is afloat is very short. *Sixthly*, That the lock, and the space requisite for vessels waiting to dock and undock, will occupy a considerable portion of the best room in the harbour. *Seventhly*, That a portion of the backwater which scours the harbour and the bar will be locked up, and thus the benefit be in future lost. *Eighthly*, That for ships wind-bound, or having come for refuge, the harbour is so preferable that they will not go into the dock.

Those who take the dock view of the question meet all the above arguments by the paramount necessity of docks, for the reasons I have already described; that the most convenient plan for them is near the town; that less harbour-room will be wanted if the large vessels and large steamers use the dock; that the conversion of part of the harbour into a dock is the only plan within the means of the trust; that the effluvium which now exists in the upper part of the harbour at low water will not be prevented even by new sewers, unless the shore be kept covered with water; and that the plan of 1829, when the last Act was passed, contemplated the conversion of a large portion of the harbour into docks, and ought not to be departed from without good cause being shown.

Opinion.

Now, all the above arguments on each side are correct and useful to be attended to, but injurious if pressed too far, to the neglect of those on the other side. Take as an illustration of the last point, the recommendation for adhering to Mr. Telford's plan of 1829. Let it be remembered that, since then, Provost Blaikie's wall has been built in a different line from Mr. Telford's plan, that a bridge over the harbour has been built in the line of Marischal Street, instead of the shore-brae as he proposed, and that the lock, 150 feet long and 40 feet wide, which Mr. Telford's plan contemplates, would require an addition of 50 per cent. to its length and width to receive the present large class of

APPENDIX C.

ABERDEEN.

No. 193.
Walker, on the Harbour and proposed Docks.

steam-ships. Under such circumstances, it is quite clear that Mr. Telford would (where he now alive to be consulted) have proposed alterations from his plan of 1829.

I have endeavoured to keep all the above considerations in view in the design now presented, which I beg to explain.

The upper part of the harbour is proposed to be converted into a dock, by a lock 220 feet long by 60 feet wide, the inner or west end of which is a little to the east of Church Street, and the outer or east end 450 feet west of Wellington Street: this is considerably farther to the west, and leaves more harbour and less dock-room than the former plans. My reasons for this are given in the arguments already stated; and to those it is also to be added, that small vessels will prefer the harbour to the dock if there is a difference in the charge, and that such vessels are not desirable customers for a dock unless the chamber of the lock can be filled with them, as the trouble of docking and undocking is nearly the same, and the quantity of lockage water the same, for a small as a large vessel; besides, that the prior right of the trade, for which the open harbour is preferable, ought to be respected. On the accompanying plan, the dock below Regent Bridge will have an area of 12 acres, and a quay frontage of 2700 feet. I propose to make full compensation for the diminution of dock-room below, by a dock above Regent's Bridge, which will also contain an area of 12 acres, and a length of 3000 feet of quay frontage. This inner dock will be obtained at a comparatively small expense, and will be conveniently situated for the town. The width of quay-room, on the south side of it, will be from 200 to 300 feet, all of which may be applied for bonded timber yards, buildings, or other dock purposes. The two docks contain an area of 24 acres, sufficient for 240 ships of 300 tons average burden, and 5700 feet in length of quay-room.

The harbour outside the lock will enable the vessels to come so near the town as to prevent, I trust, a reasonable application of the arguments against converting part of the harbour into a dock. The harbour, from the lock gate to the north capstern, will exceed 2200 feet in length; on the west side of this a spacious quay may be formed, as the trade requires. The space below the quays, on the east side, may remain as at present, occupied by shipbuilders, or formed as quays for the whole extent of that side. A basin may also be afterwards formed there if required, leaving one side for a quay, and the other for shipbuilding, or a convenient floating dock may be constructed on the same site to the extent dotted, and tinted *red* upon the plan; this ground, therefore, I advise being *held in hand*, to be applied when the wants of the port appear to require it.

Seeing the great and increasing value of ground in Aberdeen that is applicable to shipping purposes, I have looked with some degree of jealousy at the considerable width occupied by the *river* and the *spill-water*, when, a little higher up, one channel does for both. Why, opposite the town, where ground is so much more valuable, should a greater width of waterway be taken, than at a short distance above, where all the water passes through one channel?

That some increase is necessary, I admit, but I more than doubt the utility of so great a space. I take the history to be this—that before the improvements were begun, the flood and tidal waters occupied, at times, the whole space between the high grounds on each side; that when the land floods, without the tide, were high, the river overflowed its low sides into the channel close to the town, which was then a kind of waste watercourse; that when it was considered proper for harbour purposes to prevent this overflow, and to form a new channel for the river, another waste or spillwater course was, by some party, thought necessary. I may be wrong (and my short acquaintance will be my excuse) in saying that, by straightening and widening the present spillwater, principally at the ends, it may be made sufficient for the purpose of *fishing* and a *watercourse*, with a hauling-ground on the side, by which a great addition might be made to the shipping accommodation; and when the docks and harbour now proposed are found inadequate, this seems the most natural ground for supplying the deficiency. I have not, however, attempted to meddle with this ground in the present design, and only name it as deserving attention when a further enlargement comes to be required. The plan submitted will be considered to go far enough, probably too far, but in a general design for improvements it is proper not to confine one's ideas to what can be immediately executed. An advantage of the plan is, that it may be effected progressively, and in parts, as the extent of the trade and resources permit, but the cheapest and best plan would be to do the whole at once.

Sewers.

The nuisance of the sewers that discharge into the harbour above Regent Bridge is too well known to require any description. The remedy proposed for it will, I trust, be effectual I propose continuing the new sewer upon Regent's Quay, along Waterloo Quay, and into the harbour, in the direction of the dotted line upon the plan, and also up to the line of the Mill Burn; also to form a new sewer from the Mill Burn, in a westerly direction, to take also the waters of the Denburn, and to continue the same along a street or road proposed to be made parallel to the river at the back of the Fishers' reserved ground, until it discharges into the harbour below the intended lock. This will give a great facility of future drainage for the south end of the town and the proposed quays. By means of sluices, the water of the Mill Burn may be passed through the town sewer for scouring it, or, in flood times, through the new sewer, which has also a waste weir into the river for floods.

Entrance to Harbour.

Of the entrance, which is the principal feature of almost every harbour, I have as yet said nothing; nor have I, in the plan or estimate, contemplated anything being done to it. If any material improvement had suggested itself, I would have named it; but there did not, nor does it appear to me that much can be effected without a still further extension of the pier, which has already acted so beneficially.

Estimate.

The estimated amount of all the works contemplated by the plan, including the deepening of both docks to the level of seventeen feet under high water, average spring tides, is as follows:—

Inner dock	£29,300
Outer dock and lock	40,000
Sewers, &c	8,700
Contingencies, 10 per cent.	7,800
Making a total of	£85,800*

J. WALKER.

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* This estimate, before going into Committee, was increased to 90,000*l.*, in consequence of a suggestion having been made for enlarging the dimensions and increasing the length of the sewers.

No 194.
Walker, on proposed improvements in the Harbour.

No. 194.

Report by JAMES WALKER, Esq., C.E., *on the Plan of* Messrs. HOGARTH, PIRIE, & READ, *for Proposed Improvements in the Harbour of Aberdeen.*

GENTLEMEN, *Aberdeen, September* 4, 1838.

THE plan of Messrs. Hogarth, Pirie, and Read, for proposed improvements in the harbour, has been submitted to me, in terms of the resolution of the Harbour Trustees of the 29th August. I have also received copies of the various letters respecting this plan, that have appeared in the newspapers.

To enable me to judge correctly as to the facility and expense of executing the above, I requested levels to be taken, and sections made, of the site of the projected works; this has been done b Mr. Smith, and I have since surveyed the ground.

Having learned how respectable the projectors of the new plan are, and there being several points on which it appeared to me that an explanation was desirable, I suggested a meeting, which the three gentlemen, and Mr. Gordon, master of Shore-works, attended. The result, I am glad to say, by narrowing the points of difference, has been to render a long discussion by me, on the merits of the plan, unnecessary.

I suggested that the engineer or contractor who had made out the details of the estimate should attend the meeting, that I might endeavour to agree in amounts with him, but Messrs. Hogarth, Pirie, and Read had thought this unnecessary. At our meeting, however, it soon appeared that I was correct, as questions presented themselves which the gentlemen considered themselves not qualified or not at liberty to reply to without their Surveyor's knowledge and approval. This was to be applied for, and the result, if favourable, communicated to me by Mr. Read. Not having since had any communication,* I conclude there is an objection or difficulty somewhere to giving details of estimate.

The first great *feature* in the new plan is to receive the contents of the town drains into the harbour, as at present, in place of into the new sewers proposed by me, and to erect sluices at the upper end of the harbour, which, on being occasionally opened, would draw water from the dock and scour through the harbour. A discussion on the comparative merits of the two plans led Messrs. Hogarth, Pirie, and Read to agree with me that the sewers are preferable; and it is therefore unnecessary to say more on that part of the design, or, I apprehend, longer to delay applications for tenders for the sewers, the plans and specifications for which are prepared.

The other alteration of Messrs. Hogarth, Pirie, and Read is to leave the present harbour as it is; to convert the *Inches*, along with the present site of the river and of the Spillwater, into a wet dock; and to cut a new channel, sufficient for all the water, through the land on the south side of the present Spillwater. It is of little consequence to the Trustees, whether the gentlemen took the idea from my Report, where, however, it is clearly expressed, excepting that they have gone farther than I contemplated; for the cutting of a new channel through the Torry Haugh I have no pretension to—it is, so far as I know, their own. Their plan shows a dock of eighty acres; but they state the intention of having at first the north side only excavated for a width of 350 feet, giving an area of about thirty-two acres: a small entrance basin is proposed; the north side only of the dock is to be walled, which will be 4000 feet; a bridge is to be built over the harbour in the line of Church-street; a lock between the harbour and the dock at the upper end is proposed for small vessels; also, a lock between the dock and the river, for receiving timber into the dock. The depth is proposed to be nineteen feet of high water at spring tides; and here I take the opportunity of correcting an error, made unintentionally, I am sure, by Messrs. Hogarth, Pirie, and Read, by supposing that I intend the depth of my lock to be only seventeen feet: this is nowhere said. *I* have stated that the estimate includes deepening the dock to seventeen feet; this may be increased, but the lock cannot be deepened after being built, and therefore I have made it several feet more than the dock.† My estimate of Messrs. Hogarth, Pirie, and Read's plan is 185,000*l.*; but the gentlemen agreed that the plan involves an interference with the Fishings, which would require to be purchased at from 60,000*l.* to 70,000*l.*—say together, 250,000*l.* I can see no reason why the Fishings should not be added as part of the estimate, although a part or the whole of the expense will ultimately be repaid. This will probably be the case upon all the expenditure, by the gradual increase of rates arising from the better accommodation and the increase of trade; but still a capital must be raised, in the first place, to make the purchases in the one case as to do the work in the other. But would the claims for interference with, and supposed damage to, the Fishings end here? May not the owners or lessees of the Fishings above the part of the river proposed to be diverted, discover that their Fishings also may, by possibility, be injured? This may be a very unreasonable supposition on my part; and I am prevented from doing more than naming it, as Mr. Hogarth and I have discovered that each of us understands his own business the best, and have resolved to adopt the "*ne sutor*" principle—he abandoning, henceforth, all engineering for Aberdeen Harbour, and I agreeing not to display my ignorance of the nature of Salmon Fishings. It is, however, no breach of this mutual compact to say, that by the perusal of evidence and documents I have found that in their conduct the fishers upon the Dee are, as respects interference with their property, however remote, but little disposed to follow the example of the fishers in apostolic times.

In round numbers, therefore, if 100,000*l.* is required for the works stated in my plan, 300,000*l.* should be taken for Messrs. Pirie and Read's plan, with a dock of only 350 feet width; and I would add, that from its nature and extent there is much greater contingency in the execution of their design. Much of this difference is in the quantity of excavation, arising from their level being assumed, without proof by correct levelling.

The objection to my design is, that it converts part of the Tidal Harbour into a *dock*. Now, I named this objection in my Report, where I endeavoured fairly to state the arguments on both sides, and I then came to the conclusion of what appeared to me, on a comparison of the whole and under all circumstances, to be the best for immediate adoption; and that opinion is not shaken by the consideration I have given to Messrs. Pirie and Read's plan. I stated to these gentlemen some engineering errors in their design, which, after consideration, they frankly allowed; and therefore, the few remarks I shall make are after these corrections, and with the *sewers*, on which there is now no difference of opinion.

I think *eighty* acres, the ultimate area of the one proposed dock, too great for one entrance basin or lock. That it is a splendid size I admit, for it is thrice the size of the largest dock I can at the moment remember; but splendour is not always consistent with prudence or utility; while, to be gigantic is often to be shapeless, and almost always unwieldy, and this eighty acres dock is not an

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* See Postscript.

† From a note to Mr. Walker, from his partner in London, received since this Report was in type, it appears that the sill of his (Mr. Walker's) lock is 21 feet, but the botton of the dock 17 feet.

APPENDIX C.

ABERDEEN.

No. 194.
Walker, on proposed Improvements in the Harbour.

exception. It is only when placed by the side of this splendid giant, that my plon, which has twenty four acres of docks, can be considered dwarfish, or, to use Messrs. Pirie and Read's epithets, "narrow and contracted." I think the St. Catherine's Dock in London is only eighty acres. I am sure that the Junction Dock at Hull is only six.

Hull, of which the trade is chiefly east country and coasting, and of a very varied nature, like that of Aberdeen, has two entrances for twenty-four acres, the area of the three docks, and both entrances appear to have ample employment. A fourth dock is now proposed with its own lock, and the Corporation of the town insist that, with a view to prevent delay and confusion, there shall be also a distinct entrance *basin*. Messrs. Pirie and Read suggested remedying this by another lock, to enter their dock from the harbour, which would subject the design to one of the objections touching the harbour they have made to mine, while their bridge across the harbour, though a less obstruction than my lock, is so far an obstruction as only one vessel can pass through it at a time.

Another inconvenience, from one dock of this great area, would be felt in the current of water through the lock when both gates are open. A small lock at the upper end might occasionally diminish this, but still the current would be such that the communication between the harbour and the dock, except by locking, must be shut off at the instant of high water, and this must be narrowly watched to prevent danger to the works. Again, by appropriating the whole of the *Inches* to form one dock, Messrs. Pirie and Read appear to enclose at once, within a lock sixty feet wide, the whole area applicable to dock or harbour purposes. Now, whoever looks back at the changes that have taken place in the kind of accommodation required for shipping during the last *twenty* years, will I think be indisposed, if prudent, to commit himself so far as to decide now the kind and dimensions of accommodation that may be wanted in future; and for this it seems desirable, if it can be done without interfering with what is required for present accommodation, to keep the Inches and the site of the river in reserve, to be employed as may appear the best when more room is wanted. This was my idea, my plan was made on it, and I cannot think Messrs. Pirie and Read have improved upon it. Even supposing the *design* of Messrs. Pirie and Read to be the best that can at present be devised, and that there were no want of funds, I certainly doubt the prudence of thus cutting up the whole web, the only one that is to clothe the family for future generations, into one great garment of the present fashion. This need not, however, prevent the purchasing and holding of the river Fishings, if there are the means of purchasing them, and the probability of their rising in value.

The time which the proposed plan would require to execute appears another argument against it.

I avoid remarks as to the size of the entrance basin, the exposure of the lock-gates to the swell of, and to be struck by, the waves, and many other points, because they are capable of at least partial remedy, although not without an increase of expense, and because I do not think, after the candid way in which Messrs. Pirie and Read met me, that it would be liberal to make the details of their plan the subject of detailed professional criticism. Had their Surveyor met me and acknowledged the plan as his, I might not have felt under the same restraint.

There are then three ways of receiving the question. They are all liable to objection, and it is for the Trustees to consider which has the least.

First, The harbour may be left untouched, except with a continuation of the gradual extension and deepening which it has from time to time had, but without a *dock*.

Secondly, A part of the harbour space, below Regent Bridge, may be applied to form a floating dock of twelve acres, and another dock of twelve or fourteen acres be made above the bridge—both docks being certainly most conveniently situated for the town, and giving the opportunity of extension upon the Inches when required.

Or, *Thirdly*, the Fishings may be purchased (for to touch the river, it is admitted, includes this), and part of the Inches, with the channel of the present river, at once appropriated to dock and harbour purposes, in a way different from that proposed by Messrs. Pirie and Read, but not probably at less expense.

The decision is now with the Trustees. I would only again remark, that the execution of the limited plan will not prevent the extension of an ulterior measure upon the ground to the south when it may be requisite; and that on the whole, and as a first step, the limited plan appears to me the most advisable and only practicable plan under the present circumstances.

I am, &c.,
J. WALKER.

P.S.—Since writing the foregoing, I have received the following note from Mr. Read, who has called upon me:—

"Messrs. Hogarth, Pirie, and Read, having been furnished by Mr. Walker with no satisfactory arguments to show the advantages of his plan of harbour improvements, which involves the sacrifice of the present excellent tide harbour, would take permission to bring under Mr. Walker's notice, that, as he has already referred to the subject of the sites of the river and Spillwater, as occupying more ground than he would recommend, and as he contemplates ultimately the occupation of that ground for the purposes of the harbour, it would save much discussion, and reconcile conflicting opinions, if Mr. Walker would now state his views on this subject, and give such a plan of a dock, in that situation, as would render unnecessary any interference with a most commodious tide harbour, which has been formed at a very great expense.

"*Aberdeen, September* 4, 1838."

Mr. Read also informed me that his Surveyor was not in Aberdeen, and that this was the cause of my not seeing him.

To the Lord Provost, Chairman, and the other
Members of the Board of Harbour Trustees,
Aberdeen.

APPENDIX C.

ABERDEEN.

No. 195.
Abernethy, on forming Wet Docks.

No. 195.

Report by J. ABERNETHY, Esq., *on the Advantage of constructing Wet Docks, and Estimates.*

Engineer's Office, Aberdeen, July 6, 1842.

GENTLEMEN,

BEFORE entering on the subject of the internal improvements of the harbour, I have thought it necessary to take into consideration the evils at present existing in the harbour entrance, being convinced, from the constant trouble and expense caused by them, that they are well worthy of special attention; and also that provision should be made for an additional depth of water there, as well as in any dock which may be projected. The evils referred to are—

1st. A certain swell, or in-run of the sea, into the harbour during easterly gales.
2nd. The accumulation of a bank at the point marked A on the plan, between the south pier-head and breakwater.
3rd. The accumulation of a bank at the point marked B on the plan, and another to the southward at C.

With respect to the first, it is an acknowledged fact that the best way of breaking the sea is to allow it to expend itself on a flat beach or slope; and, on looking at the direction of a wave rolling up the entrance of Aberdeen Harbour, it appears evident that, with a flat beach to the southward, it could not, from the direction of the harbour, cause any material swell at the quays; but unfortunately the south pier intercepts the sea, coops it up, and gives it a northerly direction, instead of allowing it to expend itself, as it would naturally do, on the southern shore of the harbour. The south pier, therefore, I am of opinion, is in a great measure the cause of the in-run or swell in the harbour during easterly gales.

In respect to the second evil referred to, viz. the bank at A on the plan, between the south pier-head and breakwater—this is no doubt caused by the current of the river, which is confined between the north and south piers, being allowed to expand itself, causing an eddy, and that at a point of the harbour-entrance where its whole force is most required to scour the bar. The stream being confined to the northward by the pier, the channel is deep, and if confined to the southward it would be the case there also. But keeping in view that there is at times a great in-run of the sea, any barrier there would require to be of the nature of a slope or beach, smooth, and uniform longitudinally.

Seeing, then, that the south pier, in its present state, is of no service whatever, but is a positive evil, I would recommend that it be taken down to the level of low-water mark and rebuilt up to the level of the highest spring tides, in the form of a long flat slope, as shown on the accompanying section. Next, progressively, and as the season would permit, I would excavate, by dredging and otherwise, a trench to the depth of at least the foundation of the north pier, eastward to the breakwater, and build therein, with rough stone blocks, which can be got close at hand, a bulwark of the form shown in the section. This would confine the current, make the channel of a uniform depth, and also allow the sea to expend itself upon the slope.

In respect to the third evil, viz. the banks at B and C on the plan, I am of opinion, the first is caused by the current of the river being discharged, owing to the direction of its banks, too far to the southward. To remedy this I would recommend that Point Law be extended to the eastward, as shown on the plan, and terminated with a slope of a form similar to the point of the north pier. If this were done it would turn the current more directly into the channel of the harbour-entrance, and, I doubt not, would speedily remove the bank B. With respect to the accumulation to the southward at C, this proceeds from the same cause as the bank at the harbour-entrance, and may be remedied in a similar manner, by extending the flat slope to the westward, as shown on the plan. With respect to improving the internal portion of the tidal harbour, it will be necessary that the Waterloo and Provost Blaikie's Quays be extended each 100 feet beyond the proposed lock, as shown on the plan; and, as the harbour is now dredged to an equal depth from side to side, and to prevent the stuff from the "Inches" falling back into it, the bank forming the south boundary of the harbour should be formed into a regular slope, well faced with stone, as far as the North Capstern.

The next subject for consideration, in regard to the improvement of the harbour, is the construction of wet docks.

The superiority of wet docks over a tidal harbour is on all hands admitted; and when we take into consideration, the increased size of the shipping belonging to, and frequenting, this port, and the alteration in the models of vessels, even since the last Harbour Bill was before Parliament in 1839, the necessity of a wet dock, or docks, is, I think, almost imperative. In submitting a plan of wet docks for this harbour, I beg to state that I do so with the utmost diffidence, being aware of the many difficulties surrounding the question; and although much valuable information is to be acquired from the various schemes formerly devised by eminent engineers for its improvement, it is still necessary to keep in view, in any plan now proposed, the great changes which have recently taken place in the size and description of vessels, and also the fact, that harbour works which were executed some years ago, and which then were judicious, are not found to be so as regards the present time.

This arises, in a great measure, from the increase in the size and the number of steam-vessels now employed; and as it is not unreasonable to suppose that much larger vessels may yet be built, I have kept in view, not only a provision for the present wants of the shipping, but for a future increase in their size. A general error, in locks of wet docks constructed some time ago, is a deficiency in width; and although a lock of extra large dimensions materially increases the expense, in my opinion the advantages to be derived from it more than counterbalance this otherwise weighty objection. The lock I propose to be 250 feet long, by 60 feet wide, which will admit of a steamer of larger size than the "City of Aberdeen." Four vessels of 200 to 250 tons, or six vessels of 100 tons, may be locked in at the same time. Such a lock, as regards despatch, has a great advantage over a lock of smaller size; for although a much greater quantity of water is required to fill a large lock, still, by proportionally increasing the size of the valves, or passages for the admission of water, it may quite as safely be filled in a short period of time. In case of a single vessel, or two vessels of small size, requiring to be locked either in or out, it would be a waste of water to fill a large lock for the purpose when a smaller one would do; to meet this objection I propose to have a third or intermediate pair of gates in the lock, as shown on the plan, thus dividing it into two parts of unequal length, whereby a saving of water will be effected in locking in or out a single vessel, the lower gates being only used in locking a large steamer, or a number of vessels, into or out of the dock at one time.

Appendix C.

Aberdeen.

No. 195.
Abernethy, on forming Wet Docks.

After maturely considering the various plans and reports of the different engineers who have at various periods been employed in devising schemes for the improvement of this harbour, I am of opinion that the present tidal harbour, with certain alterations in the line and construction of the quay-walls, is the best site for a wet dock. It is the most contiguous that can be chosen to the city, the quays forming the north boundary of the dock, with ready access by Commerce Street, Marischal Street, Market Street and Gas Street, to all parts of the town; and with respect to extension afterwards, by cutting a new channel for the river, the dock room may be increased to a great extent southward; but, from the large size of the dock proposed, this will not be required for a considerable time to come.

With respect to the size of the dock, and accommodation afforded therein, I beg to observe, in the *first* place, that, with a view to the proposed works being executed in a proper and efficient manner, I have carefully investigated into the nature and stability of the works at present existing; and the result is, that with the exception of Regent Quay, and a portion of Provost Blaikie's Quay, which it is proposed to secure from leakage, I am of opinion that the remainder of the walls is not adapted to form part of a wet dock, with a sufficient depth of water to accommodate the present wants of the shipping. I propose, therefore, to rebuild them of sufficient depth, in the lines shown on the plan, which will give a considerable additional area, particularly in the upper part of the dock, where it is desirable to have it. The dock covers an area of 37 acres, capable of accommodating, with facility, 300 vessels, of from 200 to 300 tons, which, when the plan is fully executed, will have 4710 feet of quay room having 19 feet of water, and 1980 feet of quay room having 16 feet of water, ordinary spring tides—in all, 6690 feet, capable of accommodating 66 vessels, supposing them 100 feet long on an average. The sill of the lock should be laid for 21 feet, and the walls founded for 19 feet water, ordinary spring tides, which is as much as can at present be attained outside the dock gates, as may be seen by the soundings marked on the plan; but if the alteration in the harbour entrance be carried into effect, with a little assistance from the dredge, I do not anticipate any difficulty in gaining an additional depth of two, or perhaps three, feet, without and within the dock gates, and the walls may be so constructed as to admit of the dock being deepened to 21 feet of water with safety, when required.

From the great breadth of the dock proposed, the quay-room may be considerably extended, by the erection of jetties, when required, as shown on the plan, at a comparatively trifling expense, while the great area will supply a sufficient quantity of water for lockage, without material diminution in the level of the surface.

It is not necessary, for the accommodation of the present wants of the port, that all should be done immediately; a portion will suffice.

On this point, having, by desire of the Committee, consulted with Mr. Alexander Gibb, we drew up a joint report pointing out what part of the plan we consider necessary to be immediately executed. This would give a dock of 31½ acres, capable of accommodating from 90 to 100 of the smaller class of shipping, and 200 vessels of the larger class; 2450 feet of quay-room having 19 feet of water, 1980 having 16, and 985 having 14 feet ordinary spring tides—affording ample accommodation for the wants of the port, probably for many years to come. A sufficient depth of water to accommodate some large vessels, in any part of the harbour, may, when required, be had alongside the jetties.

The next important point in connection with the wet docks is the devising of a plan of sewerage. In my first report to the Improvements Committee, I pointed out a line of sewer, from the Denburn, by Wapping Street, Guild Street, Trinity Quay, Weigh-house Square, Virginia Street, and Canal Terrace, to the end of Waterloo Quay.

On reconsidering the matter, however, I have, for various reasons, made the alteration shown on the plan, which shortens the length of the sewer, thereby lessening the expense.

I propose to construct a dam, sufficiently high, across the Denburn, to arrest the ordinary flow of water, and to turn it into the mouth of the sewer—the sewer mouth to have a sluice upon it, so as to admit the usual quantity of water; it can also be opened to any extent to admit an extra quantity in times of speats, for the purpose of a scour, if required; the speat-water of the burn to be discharged by its present channel, and a proposed overflow channel across the Inches, at Poynernook, into the river Dee. The line of sewer then runs along Wapping Street, through a yard at the angle of Gas Street and Guild Street, along Trinity, Regent, and Waterloo Quays, to the end of the proposed extension of Waterloo Quay, where, for the present, it is discharged into the harbour at the low-water line, medium tides.

The total length of the sewer is 4560 feet, with a fall of six feet, and an area of forty-eight feet.

James Abernethy,
Resident Engineer, Aberdeen Harbour.

To the Committee for Harbour Improvements.

Estimate by Mr. Abernethy.

The estimated Amount of all the Works contemplated by the Plan is as follows:—

Outer Dock and Lock	£60,190
Inner Dock	24,000
New Quays in Tidal Harbour	1,900
New Works at Harbour Entrance	2,000
Sewer	12,160
	100,250
Contingencies, 10 per cent.	10,025
Making a total of	£110,275

James Abernethy.

APPENDIX C.

ABERDEEN.

No. 195.
Abernethy, on forming Wet Docks.

Mr. ABERNETHY *to the Committee for Harbour Improvements.*

GENTLEMEN,

August 1, 1842.

As in my opinion several very important improvements at the harbour entrance might be effected, in connexion with certain alterations in the river, I have deemed it advisable briefly to point them out. On the accompanying plan (*A* 2) I have laid down the proposed improvements.

First. Across the narrow neck of land separating the river and Spillwater channel I propose to cut a channel, and with the material arising from this excavation form an embankment across the present channel of the river, as shown on the plan.

Second. To widen and deepen the Spillwater channel beyond this to its mouth, until it is sufficiently capacious to contain twice the ordinary waters of the river, as a provision in case of spests or floods. The excavation arising from this operation would be of great value as material in carrying on the works connected with the proposed wet docks—being composed of fine clay, which is only to be procured at this particular spot.

Third. To excavate or remove the point of the Inches from the North Capstern to within 400 feet of the proposed lock—forming the end into a sloping beach, so to allow any swell or inrun into the Harbour to expend itself. This would form a spacious entrance basin of about 28 acres area, where the largest vessels may wind in safety, and the worst part of the present navigation of the harbour entrance, namely at the junction of the harbour and river Dee, be at once removed. From its great size, also, wind-bound vessels might ride in the basin moored to buoys, completely removed from the Fairway channel.

JAS. ABERNETHY.

Estimate and Report by Messrs. ABERNETHY *and* GIBB.

GENTLEMEN,

Aberdeen, August 8, 1842.

Estimate by Abernethy and Gibb.

AGREEABLE to the order of last Committee, we have prepared the following probable estimates:—

1st.	On the supposition that a lock be constructed at the end of Waterloo Quay—the quay-walls to remain as they are at present	£33,000
2nd.	On the supposition that a lock be constructed at the end of Waterloo Quay—the lower portion of the harbour deepened to 18 feet, ordinary spring tides—Waterloo Quay and Provost Blaikie's Quay secured by piling, &c., and Provost Blaikie's extended to the lock	54,751
3rd.	On the supposition that a lock be constructed at the end of Waterloo Quay—Waterloo and Provost Blaikie's Quays rebuilt, and founded of sufficient depth for 21 feet of water, ordinary spring tides, and the lower portion of the harbour deepened to the same extent	84,197
4th.	On the supposition that a lock be constructed at the end of Waterloo Quay—Provost Blaikie's and Waterloo Quays rebuilt in the lines shown in Mr. Abernethy's plan, which gives an additional area of 7¾ acres, the walls founded for 21 feet of water, and the harbour deepened to the same extent	94,811

We give it as our opinion that the first and second plans, although the cheapest, are not the best; as regards the first, because even if found to answer the purpose, still we consider 16 feet of water, ordinary spring tides—liable to diminish in neaps—as too little for the wants of the port; and in regard to the second, we consider that underpiling the walls is attended with risk to their stability.

To the Committee for Harbour Improvements.

JAS. ABERNETHY.
ALEX. GIBB.

APPENDIX.

Extract Letter—Mr. LESLIE, *Engineer, Dundee Harbour, to* Mr. ABERNETHY.

SIR,

Dundee, July 2, 1842.

In reply to the queries contained in your letter of yesterday, I beg to inform you that there is no sewer discharged into the docks of Dundee.

We could not possibly do so, as the sewer which drains the greater part of the town, and is the outlet of a considerable burn, is so low at its point of discharge as to be little above the level of low water. Even had it been high enough to discharge into the docks, it could not have done so *without serious inconvenience* from the deposit which would have taken place in consequence.

The sewer is 3½ feet wide, and 7 feet high; and is discharged into the new tide harbour at the point C, as marked in the plan which accompanies this. It is objectionable to discharge the sewer even into the tide harbour, as there is no current there to carry away the mud and filth, which therefore deposits to some extent; but this is remedied, in some measure, by giving a scour from the docks, at low water, from the point A, and from another sluice which we have in King William the Fourth's Dock. Before the new dock was commenced, the sewer discharged at the point B, and it was a question whether it had not better have been carried out to E, and it might probably have been so, were it not that a drain, to or from the eastward, was wanted at any rate; and also from the possibility of the graving-dock being extended and divided, with an entrance from the new dock, which would have interfered with the sewer, as the lock would do at the east end of that dock.

I am, &c.,
JAMES LESLIE.

James Abernethy, Esq.,
Resident Engineer, Aberdeen Harbour.

Copy Letter—Mr. HARTLEY, *Resident Engineer, Liverpool Docks, to* Mr. ABERNETHY.

SIR,

Dockyard, Liverpool, July 4, 1842.

In reply to your letter regarding the sewerage here, I have to inform you, that a few years ago the sewerage of the town was all discharged into the docks and basins; since which, an Act was ob-

No. 195.
Abernethy, on formingWet Docks.

tained by the town, in accordance with which the Dock Trustees have taken the sewerage in some cases directly into the river, clear of the docks; and, in other cases, such has been done by the town. Two of the basins yet receive a portion of it.

The dimensions of these sewers are various, according to the extent of surface to which each sewer applies. The smallest is three feet wide, by four feet six inches high; and the largest, seven and eight feet wide, and of proportionate height, according to circumstances.

To your third question, I have to say, that the sewerage discharging into the docks was a great nuisance: it is not a pleasant thing to empty into the basins; but there is this advantage, that, where the sewerage water, &c., goes, there are no worms to destroy the timbers.*

I am, &c.,
J. HARTLEY.

James Abernethy, Esq.
Resident Engineer to the Harbour Trust, Aberdeen.

Extract from Messrs. TIMPERLEY's *Account of the Harbour and Docks at Kingston-upon-Hull.*
From "Transactions of the Institution of Civil Engineers," vol. i., page 26.

As many as 25 sea-going vessels have passed the Humber lock in a tide; thirteen of the largest when the gates were open, for about an hour, at high water, and the rest by penning. (The lock is 158 feet long, and 42 feet wide.)

There are usually three men to open or shut each gate, which they do in two minutes and a half; but, frequently, two men do the work with 6 or 7 feet of water on the sill. In average tides, the lock can be emptied, or filled, in about eight minutes, with all the sluices.

Copy Letter—Mr. LESLIE, *Engineer, Dundee, to* Messrs. JOHN GIBB and SON.

DEAR SIRS,
Dundee, August 17, 1842.

The London steamers sail directly from the dock only when the time of sailing comes to be at, or near, high water; but the hour of sailing is sometimes shifted an hour or two to suit the tide. When the tide does not suit, the vessel goes out at the high water before the hour of sailing, and takes in the last of the cargo and the passengers in the river.

When the departure is direct from the dock, the passengers, and occasionally some light goods, are taken on board *in the lock*, so as to save the time occupied in winding the vessel, and bringing her from the quay to the lock; and, therefore, a considerable time is necessarily spent in the lock in the embarkation, even when the water is level. It is, therefore, no object to hurry the locking out, especially as the lock is so large as to be capable of passing *four times the number of vessels that are ever likely to use it. With the ordinary number of hands, it takes about a quarter of an hour to open or shut one pair of gates and sluices; but, by getting some extra hands, much greater expedition could be used; and I have no doubt that the vessels could be passed in half the time.*

There are eight dock-gate men, viz. four at each capstan, and there are no other people paid to do the work; but I can see no difficulty in getting some extra men at tide-time; and I have a notion that in the case of very heavy gates, and much locking, it might even be worth while to have a small steam-engine on each side for opening and shutting them.

I am, &c.,
JAMES LESLIE.

Messrs. John Gibb and Son.

Extract Letter—Mr. WITHERS, *Treasurer, Liverpool, regarding the time occupied in passing Vessels through the Locks at Liverpool.*

The harbour-master of Liverpool says he has sent into the river, from the Queen's Dock Basin, 35 vessels (varying from 60 to 500 tons) within 45 minutes.

Extract Letter—Mr. JAMES MAY, *regarding the time occupied by Vessels passing through the Locks of the Caledonian Canal.*

Clachnaharry, Inverness, August 17, 1842.

The process of vessels passing through the locks of the Caledonian Canal occupies 20 minutes for each lock, in ordinary cases. Steam-vessels can be passed through with greater rapidity, from their possessing within themselves the power of locomotion, and can accomplish as much as *five* or even *six* locks within the hour. So also may light sailing craft, on account of the gates not requiring to be completely opened for their admission. The rise of each lock on the line of the canal is 8 feet.†

No. 196.

Report and Estimate on proposed Wet Docks, by Messrs. ABERNETHY and GIBB.

No. 196.
Abernethy and Gibb, on proposed Wet Docks.

GENTLEMEN,
August 9, 1842.

AGREEABLE to the order of last Committee, we have taken into consideration a plan for wet docks, with a lock having a single and double pair of gates at the end of Waterloo Quay; the sill of the lock laid for 21 feet, and the walls (with the exception of Regent Quay, and a portion of Provost Blaikie's quay) founded for 19 feet of water, ordinary spring-tides. The plan proposed is a portion of Mr. ABERNETHY's plan, shown on the drawing coloured red. We propose to rebuild Waterloo Quay, as shown in drawing, which gives an additional area of one and one-sixth acres—to rebuild a portion of Provost Blaikie's Quay, as shown in drawing, which gives an additional area of one and three-fourths acres—to secure that portion of Provost Blaikie's Quay, in front of the lime-sheds and bone-mill, from leakage simply—and to extend it up to the junction with the lock; the walls in the upper part of the harbour to remain as they are at present, except being secured from leakage; and as, in winter, the only place where good ballast for vessels can conveniently be got is the excavation in the upper part of the harbour, we anticipate that, by the time the operations proposed are completed, the excavation there will have been consumed in this way. We have, therefore, not provided for it in our estimate. The south side might then be formed into a regular slope, for securing which we have made provision. We also propose that Provost Blaikie's Quay and Waterloo Quay be each extended 100 feet into the tidal harbour. With respect to the proposed improvements in the harbour

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* There is no worm in Aberdeen Harbour.—J. ABERNETHY.

† Length, about 170 feet—width, 40 feet. Height of lower gates, about 28 feet.

APPENDIX C.

ABERDEEN.

No. 196.
Abernethy and Gibb, on proposed Wet Docks.

entrance, as shown in Mr. Abernethy's plan, as stones will, from time to time, have to be lifted from the harbour entrance, the slope or breakwater on the south side may be completed progressively by depositing them there, or at the proposed extension of Point Law; for this we have provided a sum of 2000*l.* in our estimate.

Sewerage.

We recommend that the line of sewer, shown in the plan, be executed—discharging 100 feet beyond the end of Waterloo Quay. From the decomposition which will take place in the stuff passing through such a length of sewer, and its being discharged into such a large body of fresh water, we do not anticipate that any inconvenience will be felt from it; and, from its being discharged at one point, the deposit can easily be removed from time to time by dredging. The sewer can at a future period be extended to the harbour-entrance if required.

We have made out an estimate for these works, amounting to 83,875*l.*

JAS. ABERNETHY.
ALEX. GIBB.

To the Committee for Harbour Improvements.

Estimate by Messrs. ABERNETHY and GIBB.

The estimated Amount of all the Works referred to in Joint Report of Messrs. ABERNETHY and ALEX. GIBB is as follows:—

Outer Dock and Lock, and securing upper part of Harbour . .	£60,190
Sewer	12,160
Building Quays in Tidal Harbour	1,900
New Works at Harbour Entrance	2,000
	76,250
Contingencies, 10 per cent.	7,625
Making a total of	£83,875

JAS. ABERNETHY.
ALEX. GIBB.

No. 197.

Report by Mr. ALEXANDER GIBB, Esq., C.E., *on the best means of improving the Harbour.*

No. 197.
Gibb, on improving the Harbour.

MY LORD, *Aberdeen, July* 30, 1842.

AT your Lordship's request I have considered the present state of the Harbour of Aberdeen, with the view of making a few suggestions for the improvement of it, either by the formation of wet docks, or otherwise.

As some discussion has taken place, at different periods, respecting plans for the improvement of the harbour, I beg to submit several of them, in different situations, with estimates thereof. And the first plan which I propose to bring under the notice of the Trustees is the design marked No. 1, which accompanies this; and by which it will be seen that the course of the River Dee is changed in a more southerly direction; that there is an upper and lower dock, and an upper and lower tide harbour; and that the entrance to the present lower harbour is kept as it is—the lower dock, calculated to contain about 170 vessels, extending from below York Street to opposite Commerce Street—the ship-building yards being preserved as they are; the entrance to the lower dock being near the present mouth of the River Dee; with a wharf across the upper part of the lower tide harbour, immediately below York Street, and another wharf across opposite Commerce Street. By this plan the lower tide harbour will contain about 60 vessels, and the upper tide harbour about 100 vessels; the entrance to the latter being by the present channel of the River Dee, and the communication thereto immediately to the west of the bone manufactory. The entrance to the upper dock is also intended to be by the present channel of the River Dee. This dock is calculated to accommodate about 160 vessels, with a quay of access in the line of Marischal Street, and also a quay in the direct line of Market Street. The forming of a quay in the line of Marischal Street rendering a bridge there unnecessary, it would in that case be removed to the lock at the lower part of the harbour. This plan when completed would accommodate about 600 vessels.

The next point to which I have to advert is, the advantages and disadvantages of such a plan. The circumstances in its favour are, that the entrance to the docks, by making use of the present river channel, will be much more easy of access than the entrance to the present harbour. The navigation channel and the entrance to the docks would, by this plan, be nearly straight, and in a more direct line with the entrance at the mouth of the harbour, and in consequence would be more easily deepened and maintained at its depth, without much expense of dredging. The trade of the port would also be more concentrated, and more immediate access would be got thereto. The navigation channel being straight, it could be easily scoured by making use of the upper dock for that purpose; and either of the docks could be applied to the scouring of the other, and both docks could be used for the scouring of the upper and lower tide harbour. The lower lock, being so conveniently situated to the mouth of the harbour, would, without hesitation, be entered by all steam-vessels and ships of large burdens; it being quite practicable, owing to the lock being situated so low down, to maintain a very sufficient depth of water at the entrance thereto, so as to leave no doubt that it would prove of the utmost service to steam-boats and vessels of large burdens, which are of the description that stand most in need of a dock. There would also be quays giving immediate access to the docks and harbour, in the line of Market Street, Marischal Street, Commerce Street, and York Street. There would also be by this plan an acquisition of ground on the north bank of the River Dee, now used by the proprietors of the Salmon Fisheries, to the extent of six acres, and also a space of ground of about eight acres acquired a little above the Poynernook manufactory.

This plan affords considerable advantages in the way of sewerage, by giving an immediate communication through the different transverse quays, and discharging themselves into the old channel of the River Dee—together with a very ready mode of taking away the Den and Mill Burns. The scouring of the river channel can be easily effected by means of the upper dock, as already noticed. There would, by this plan, be no risk of any damages by leakage from the docks, along the properties opposite Regent Quay—the lower parts of these properties being considerably below high-water mark.

APPENDIX C.

ABERDEEN.

No. 197.
Gibbs, on improving the Harbour.

These being some of the advantages of this plan, I now proceed to its disadvantages. One of them (although this may not be a disadvantage to the plan itself) involves a considerable risk—that is, the changing of the course of the River Dee. This risk does not arise from the execution of the work, but in the indemnification or the expense to which the Trustees would be liable in consequence of changing the course of the river. The next disadvantage that can be urged against the adoption of this plan is the expense, which I estimate as follows:—

The lower dock, entrance lock, new wharf walls, and excavation	£53,700	0	0
The upper dock, entrance lock, new wharf-walls, and excavation	71,992	10	0
Upper dry harbour, excavation, and entrance thereto, and new wharf connected therewith—together with all the sewerage	14,814	16	0
Changing the course of the River Dee	12,000	0	0
Deterioration to the Salmon Fishings	8,000	0	0
	160,507	6	0
Contingencies	16,050	14	0
	£176,558	0	0

The next plan which I have to notice is that marked No. 2, which accompanies this. This design, as will be seen, preserves the channel of the River Dee as it is at present, forming a dock which would contain about 100 vessels at the lower part of the harbour on the south side, extending from the mouth of the harbour to opposite the lower end of Waterloo Quay, and the entrance thereto being at the lower part of the harbour—leaving, on the east side of the dock between it and the ship-building yards, a navigation channel of about 300 feet in width, communicating with the upper tide harbour, which would extend as far as Marischal Street, and terminate there. This lower dock would also have, in connection with it, a channel from the upper end, passing on the south side of the bone manufactory, communicating with an upper dock calculated to contain about 100 vessels—a quay across the dock in the line of Marischal Street—also a quay in a straight line from the lower end of Market Street, extending to the entrance lock, with a sewerage emptying itself below the lower jetty, and dock accommodation on the south side of the ground near which the bone manufactory is situated. The upper tide harbour, by this plan, would contain about 160 vessels: this design altogether accommodating about 500 vessels of a large class, if necessary.

We come next to the advantages of this plan. The lower dock, by being so conveniently situated at the lower part of the harbour, would be most readily used by all steam-boats and vessels of large burden, from the facilities with which they could enter and depart from it, without the risk of getting aground, or being otherwise detained. This dock would also have a convenient quay of access at the end of York Street; and, by leaving a considerable part of the tide harbour as it now is, with the same ready access to it as now exists, the formation of the upper part of the harbour into a wet dock, and the convenient modes of approach thereto, from Marischal Street and Market Street, together with the having the upper part of the harbour constantly covered with water, and a suitable sewerage connected therewith, would effect the principal objects which the Trustees have in view.

There are, also, some disadvantages attending this plan, of which the principal is, that there would still remain a very considerable extent of tidal harbour—the maintenance of which, by dredging, would, as it is now, be attended with very considerable expense. There would be required, in order to carry it into execution, a portion of the ground over which the proprietors of the salmon fisheries have a servitude on the north bank of the River Dee. Although a sufficient quantity would remain to admit of their carrying on their fishing operations, still they would require to be compensated for the loss of this portion of their ground.

I estimate the expense of plan No. 2 as follows:—

Lower dock, entrance lock, wharfs, excavation of dock, rubble walls, &c.	£64,401	17	0
Wharfs of middle communication between docks, excavation thereof, and rubble walls—together with all the sewerage	46,696	5	0
Upper dock, wharfs, and excavation connected therewith	26,925	18	0
	158,024	0	0
Contingencies	15,802	8	0
	£173,826	8	0

The next design is that represented in the plan marked No. 3. This, as will be seen, exhibits at lower dock sufficient to contain about 100 vessels, the entrance to which is below Waterloo Quay: the dock, extending itself from thence, and coming into the ground opposite Church Street, terminates at the upper end of the canal basin, leaving the lower part of the harbour and ship-building yards as they are, and forming a channel about 300 feet in width to an upper tide harbour and an upper dock. The upper tide barbour extending beyond Marischal Street, with an entrance lock to the upper dock a little above Marischal Street—removing Marischal Street Bridge, and placing it in the upper dock in the line of the quay, extending across that dock from the lower end of Market Street; together with all the necessary sewerage connected therewith, to discharge itself at the lower part of the harbour. The upper dock would contain about 70 vessels—the upper tide harbour about 130 vessels—the lower tide barbour about 100 vessels; making altogether berthage for about 400 vessels.

The advantages and disadvantages of this plan being very similar to that of No. 2 (excepting that it wants the medium communication between the upper and lower docks—the tidal harbour being used for this purpose), it is unnecessary to enlarge on them here.

I estimate the expense of this plan as follows:—

Lower dock, with entrance lock, wharfs, excavation, and purchase of property	£71,940	14	0
Lower dry harbour, with wharfs, excavation, and expenditure connected with the sewerage	49,033	6	0
Upper dock, with lock, wharfs, and excavation	38,275	18	0
	159,249	18	0
Contingencies	15,924	19	0
	£175,174	17	0

Appendix C.

Aberdeen.

No. 197.
Gibb, on improving the Harbour.

The next plan is that represented by sketch No. 4, which contemplates the changing of the course of the River Dee, leaving the lower basin and ship-building yards as they are at present—the formation of one dock from the lower end of Waterloo Quay to the Poynernook, with an entrance lock communicating thereto from the south side, and entering a little below the bone manufactory. This dock would extend its accommodation over all the present tide harbour, with the exception of the lower part thereof, and would accommodate about 350 vessels. By this plan I propose completing the upper part of the dock opposite Market Street, by the building of wharfs all round it, and excavation of a part of the interior thereof. Although it will be seen that I do not contemplate so large a dock at the upper part of the harbour as is proposed in Mr. Walker's plan, I include, however, the finishing of the interior of the dock by the completion of Provost Blaikie's Quay on the south side, down to the lock; also the extension of that quay on the south side of the lower harbour, so as to finish the same.

This plan I estimate as follows:—

Entrance lock; transverse wharfs at the end of Waterloo Quay; wharfs in the upper part of the dock, with the excavation required there; completion of Provost Blaikie's Quay; also completion of that quay without the dock, with the formation of the sewers	£69,100	0	0
Changing the course of the River Dee	12,000	0	0
Deterioration to the salmon fishings	8,000	0	0
	89,100	0	0
Contingencies	8,910	0	0
	£98,010	0	0

One of the advantages which this plan holds out is as before stated for Plan No. 1, viz.—the benefit of an immediate communication with the river. The converting of a great portion of the tidal harbour, from the lower end of Waterloo Quay upwards, into a dock, gives considerable advantages in the saving of expense, and all the objects which the Trustees have at present in view would be attained. There is, however, as already stated in the remarks in Plan No. 1, the risk attending the changing of the course of the river, if this plan be adopted. The risk by this plan might be considerably lessened, if only the lower part of the course of the River Dee were changed, and the upper part thereof left untouched: the expense would also be reduced by the adoption of such a modified plan.

The next plan to which I advert is that proposed by Mr. Walker; and having estimated the same, I am of opinion that, if the entrance lock were placed at the lower end of Waterloo Quay, and the upper part of the dock which he proposed a little curtailed, Mr. Walker's plan could, with these alterations, be executed for about 80,000*l.*—the details of which are as follows:—

Entrance lock and wharfs connected therewith; also, wharfs at the upper part of the dock; excavation thereof; wharf on the south side below the dock; with sewers	£72,750	0	0
Contingencies	7,275	0	0
	£80,025	0	0

The advantages and disadvantages of Mr. Walker's plan are so ably stated in his report to the Trustees, that it is unnecessary for me to say a word regarding them.

Taking a review of all these different plans, it will be seen that the whole of them, with the exception of the two latter, amount to large sums of money; that, where we contemplate the changing of the course of the River Dee, a lower dock, and an upper dock, the expense, in general, amounts to about 175,000*l.*; but where the principle of one dock is proposed (making use of the present harbour as a dock), with the changing of the course of the River Dee, the expense is about 98,000*l.*; always keeping in view that the changing of the river involves certain risks, which it is difficult to estimate; and it will be seen from an inspection of these plans, and a perusal of the respective estimates, that if we depart from the idea of forming the present harbour into a dock, we immediately, by every other plan, involve a much greater outlay of money. In stating this, let it not be supposed that I am an advocate for the river remaining as it is; on the contrary, I give it as my unprejudiced opinion, that, if there were no restrictions as to expense, the changing of the course of the river is the very best plan that could be adopted. But, in adopting such a plan, although I have estimated one at 98,000*l.*, yet, in the execution of that plan, there are contingencies that might arise to cause it to cost more than the sum I have stated. And, respecting the placing of the lock higher up than the end of Waterloo Quay, my principal objection to this is, that it would still cause to be continued a great expense of dredging, which is a serious burden upon the harbour: for, on looking over the accounts of the harbour for the last eight years, I find that the whole expense of dredging for these eight years amounts to nearly 29,000*l.*; but as one-half of this expense has been incurred in the embankment of the Inches, say about 14,500*l.* has been expended in *maintaining* the depth of the harbour; the other half of the expenditure, that is on the stuff going to the Inches, has, as I will suppose, gone to *increasing* the depth of the harbour. Now, it will be seen, that this makes an annual outlay of about 1800*l.* for maintaining the depth of the tidal harbour. This is a serious expenditure; and if the harbour could be so arranged that the quantity of stuff necessary to be removed to maintain the deepening of it were no more than the quantity required for ballasting vessels, the maintenance of the harbour in an efficient state would then be placed on the most economical footing.

And further, respecting the improvement of the Harbour of Aberdeen, a variety of designs might be proposed. Keeping the tidal harbour in its present state, docks might be formed at different points. A very excellent site for a dock was pointed out by Mr. Walker, on the ground occupied by the ship-building yards. A dock might also be formed on the ground near the canal basin, or in the space now occupied by James's Street, Water Lane, and other lanes—also, near the Weigh-house and Ship-row. But all these plans, although they might be very suitable for the trade of the port, would involve a large outlay in the purchase of property; and some of them would be of small dimensions, and afford but limited accommodation for vessels.

As the sewers would require plans more in detail than those which accompany this, I have not attempted to represent them.

No. 197.
Gibb, on improving the Harbour.

I am, &c.
ALEX. GIBB.

Thomas Blaikie, Esq., Lord Provost of Aberdeen.

No. 198.

Report by WILLIAM LESLIE, Esq., *on turning the course of the River Dee.*

No. 198.
Leslie, on turning the course of the Dee.

August 1, 1842.

GENTLEMEN,

IN preparing the plan which I now lay before you, I had in view providing dock accommodation for the shipping of the port, in such a situation, that while it would be most convenient for the trade of the city, it should be capable of further extension and enlargement, without altering any of the main features of the plan, and be, at the same time, within the limits of the ground pointed out by the vidimus of the Harbour Trustees, read at the public meeting of the 18th June last.

As the drawing will point out the general features of the plan, there are but few remarks necessary to explain it, so as to make it fully understood. It embraces turning the course of the river Dee into, and partly south of, the present Spillwater channel; making a ship channel of the present course of the river Dee, entering from the present harbour opposite the ship-building yards; excavating and forming a dock of 26 acres above or westward of Regent's Bridge, with a spacious quay across the present harbour, at the foot of Marischal-street, in connection with Regent's and Provost Blaikie's Quays; and forming a tide-lock, capable of admitting the largest class of steamers from the ship channel to the dock, nearly in the line of Regent's Bridge.

The sill of the tide-lock should be laid at the depth of 21 feet below average stream tides, and the east quay-walls founded as low as to admit of vessels drawing 17 feet of water. If the present walls of Trinity Quay be found not to be suitable for dock-walls, even after being underfounded, to pull them down and rebuild them at an equal depth with the east quay. If these walls are such as would stand underfounding, I would keep the west wall of the dock in a line with the present quay, of which it would form a part. If not, I would move the west wall backward, and to be more nearly parallel to Gas-street, and so as to be in a line with other docks which might afterwards be formed in that direction.

I consider that the most convenient berths for the London steamers would be at the West Quay, or at a jetty which could be constructed in the line of New Market-street.

Although the present channel of the river is wider, I believe, than that of the Clyde below Broomielaw, at Glasgow, yet I propose making it 300 feet wide at top, and 200 feet or thereby in the bottom; and as there would be no necessity, in the mean time, for quay-walls built alongside the whole of it, I would propose facing it up with rough stones for 8 feet from the bottom, to prevent sand washing into the channel after it had been sufficiently dredged; and only build about 500 running feet of quay-walls on the north side, at which vessels might lie whilst waiting for lockage.

I propose making the entrance to this channel nearly opposite the ship-building yards, so as to have it completely beyond the reach of the swell from the entrance of the harbour, and to be of more easy access from the tidal harbour.

I propose that the new channel for the river should be 400 feet wide, and secured on the north side by piles and stone facing on the embankment, to prevent the river from cutting in that direction.

As the course of the river would be as much changed as to admit part of Smeaton's jetty being rebuilt without risk of forming a bank behind it, I would propose that part of it should be erected, to prevent the swell coming into the harbour as it presently does; and which, I doubt not, were this done, and the South Pier removed, would be effected, and the lower basin rendered much more quiet than at present. As shifting the course of the river would make the current run directly down the entrance, instead of impinging against the south shore as it does at present, this would, in my opinion, have the effect of deepening the channel of the harbour entrance.

I propose that the Fish-market and Millburn sewers should be carried along at the back of the West Quay wall, until they join the Denburn, and that the whole should then be carried down the south side of the dock, and discharge into the shipping channel below the tide lock, where there would be always deep water, and a considerable current at times to wash away the silt that might be deposited; and if this were found not to be sufficient, a few days of the dredging barge, two or three times in the year, would completely clear it away.

The other sewers, viz. the Shorelands and Powcreek sewers, as they produce very little annoyance, could be allowed to discharge as at present until the funds of the harbour would admit of their being carried farther down the harbour, which, as their areas are but small, would not be a very expensive operation.

I consider the advantages of the proposed plan to be as follows:—

The position of the dock would be most contiguous to the bulk of the trade of the city, for, from the situation and acclivity of Market-street, I doubt not but it will soon be the principal passage to the harbour.

The present tide harbour would be allowed to remain nearly as it is at present. Whether the present quay-walls, were they underfounded, would be retentive of water, and be sufficient for wet docks, is a subject about which there may be a diversity of opinion; but at all events, they are sufficient for a tidal harbour, and surely it would be much better to preserve them as they are, than be at the expense of pulling them down and rebuilding them, or of making them dock-walls, after being underfounded, if there were any, even the least risk of their not answering the purpose after a tide lock had been constructed to suit them. Besides, were the present tide harbour, or even nearly the whole of it, to be converted into a dock, new quay-walls would have to be built lower down, of a considerable extent, even such as would accommodate the shipping for a time, were any accident to happen to the gates or lock, or any part have to be repaired or renewed, and the passage be stopped for a time.

The trade of the harbour would go on without any interruption until all the works were finished, and the dock ready for receiving vessels; whereas, in the event of a lock being constructed at Waterloo

APPENDIX C.

ABERDEEN.

No. 198.
Leslie, on turning the Course of the Dee.

Quay, the shipping would suffer very serious inconvenience for at least three years, by a large coffer-dam standing in the channel, with roads of approach to the same from one of the sides at least.

There would be about forty-five acres of land reclaimed from the present waste land about the river and Spillwater, which would be of considerable value for warehouses and timber-yards, until required for more dock room.

There would be provision made for extending the dock accommodation, without altering any of the previously constructed works; as a dock could be formed in the lower part of the present tide harbour, with a tide lock sufficiently large to admit of ordinary-sized vessels, drawing only such depth of water as the quay-walls, in their present state, would admit of, without underfounding; and tide harbour room could be formed farther down on either side of the Inches; or a dock could be formed on the south side of the upper dock, having a separate lock from the sailing channel, marked in light red lines on the plan.

Now, if a large upper dock be formed in the upper part of the harbour, with an entrance from the harbour, it is worth considering where, if required, an extension could be got. It would not do to extend it southward, for it would interfere with the river course; and were this obviated by turning its course, still there would, I apprehend, be a greater demand for more lockage accommodation than for more dock-room, as the size of the proposed upper dock would contain as many vessels as one tide lock could pass with facility. Indeed I am doubtful if one lock would serve for the present trade of the port, when frequently twenty or thirty, and sometimes forty, vessels sail at one tide, besides several arrivals. Were an extension of the dock, or an additional dock, formed southward, then another lock would have to be formed with an entrance from the river channel, which would incur all the cost of turning the river's course.

In this case the lower part of the harbour could not be formed into a dock, for there would be but one lock for it and for the upper dock likewise, which would be insufficient; besides, it would be constructed at the sacrifice of the upper lock, which would be rendered useless, and it would have to be of equal dimensions.

The present river channel might be converted into a dock, having an entrance from the present harbour, but then it would have the disadvantage of being removed away from the city, and of there being a drawbridge and a lock in the way, which might be open three or four hours every tide.

There would be an easy mode of getting clear of the sewerage at comparatively little cost, and in such a manner as would prevent any complaints from the salmon-fishing proprietors, which, I much fear, they would make, were the sewers to be discharged directly into the river, either at Poynernook or at the upper end of the new pier. In the mode now proposed the sewer water would be mixed with a large quantity of tide water before entering the river. Indeed it might be worth consideration whether the channel of the Denburn might not be left open for the greater part of its course, with occasional bridges.

The cost of executing the whole of the above proposed works would be about 110,000*l*.

If the quay walls would do if underfounded, there would be a considerable saving.

In conclusion, I would beg to say that it would be of very considerable advantage to those who may think of different plans for the improvement of the harbour, for the Committee to settle the amount of money that can be expended, within a given period, in the formation of docks.

If it shall be found that there are obstacles in the way of purchasing the fishings, or of turning the course of the river, which cannot be overcome, then the best plans must be devised that can be executed on the harbour property; and as several plans, thus limited, have occurred to me while considering this matter, if none of the other gentlemen who are making proposals to the Committee touch on them, I shall take the liberty, at a future meeting, of laying them before you.

I have, &c.,
WM. LESLIE.

To the Harbour Improvement Committee.

No. 199.

No. 199.
Report of Sub-Committee on the Improvement of the Harbour.

Report by the Sub-Committee of the General Committee named at the Meeting of the Inhabitants held on June 18, 1842, *in reference to the Improvement of the Harbour of Aberdeen; viz.—*

Messrs. ALEXANDER HADDEN, Master of Shore Works, *Convener;* THOMAS BANNERMAN, Manufacturer; ROBERT CATTO, Merchant; DAVID COPLAND, Merchant; DAVID CHALMERS, of Westburn; THOMAS BEST, Merchant; ROBERT MITCHELL, Manager, Leith and Clyde Shipping Company; WILLIAM JUST, Manager, Steam Navigation Company; WILLIAM LESLIE, Builder; ALEXANDER ANDERSON, Advocate; Baillie CROMBIE; Mr. JAMES HADDEN, Jun., Manufacturer.

Aberdeen, August 24, 1842.

THE Sub-Committee of the General Committee chosen at the meeting of the merchants, manufacturers, shipowners, traders, and others, interested in the prosperity of the port of Aberdeen, held on the 18th of June 1842, to whom it was remitted to consider and report their opinion as to the harbour improvements which it would now be advisable to adopt—in other words, to deliberate upon the best plan of providing a floating dock, of a sufficient depth of water, and with such other accommodations in the harbour as are suitable for the description of vessels that frequent the port, or may be expected to do so—have been diligently engaged in the business since the period of their appointment.

At an early meeting of the Committee, the following communication was made to them by the Manager of the Aberdeen and London Steam Navigation Company:—

EXCERPT from Minute of Committee of Aberdeen Steam Navigation Company.

" *Aberdeen, July* 11, 1842.

"At a special meeting of Committee of the Aberdeen Steam Navigation Company, called in terms of notice given at last meeting, for the purpose of considering the improvements proposed to be made in the harbour, in regard to the construction of a wet dock—*Present,* Provost BLAIKIE; Baillie HENRY; Messrs. A. BROWN, D. CHALMERS, A. SUTHERLAND, G. THOMSON, W. ALLEN, R. CATTO, W. DUTHIE, and W. CATTO—

A. BROWN, Esq., Preses.—

"The Committee, having maturely considered the whole question, are unanimously of opinion, that

APPENDIX C.

ABERDEEN.

No. 199.
Report of Sub-Committee on the Improvement of the Harbour.

it is expedient, and would be for the benefit of the trade of the port generally, to have constructed, with all convenient speed, a suitable wet dock, by enclosing part of the present tidal harbour; and in particular, it is the unanimous opinion of the meeting, that it would be specially beneficial for the interest of this company to have their valuable steam and other vessels kept always afloat while in the harbour; also, that, along with said wet dock accommodation, the necessary steps be taken to get removed the public nuisance which presently exists in the upper part of the harbour. The Committee, therefore, viewing with satisfaction the proceedings of the Harbour Trustees, in regard to harbour improvements, consider it their duty, as acting for the interests of the company, to use every means within their power for the purpose of forwarding the views of the Trustees, provided the wet dock be so constructed as to admit of the company's vessels being conveniently berthed therein, and the additional dues to be levied on shipping and on goods be in proportion to the rates chargeable at other ports similarly circumstanced. It was further resolved, that as soon as preliminaries for proceeding with the contemplated improvements shall have been arranged, another special meeting of this Board be called, for the purpose of considering the proposed situation of the dock, and schedule of dues to be levied under the New Harbour Bill.

"The meeting instructed Mr. Just, the Company's manager, to lay extract of the foregoing before the first meeting of the Committee on Harbour Improvements, for insertion in the Sederunt.

"Messrs. G. Thompson, jun., A. Jopp, and W. Reid, the members of Committee who were unavoidably absent from the meeting, afterwards expressed their entire concurrence in the foregoing resolutions.

(Signed) "AL. BROWN, *Preses.*"

The plan of harbour improvements adopted in 1810 was for converting great part of the harbour into a wet dock, and all the plans sanctioned by Parliament since that time have been on the same design in that respect, although the harbour is still but a tidal harbour. In the mean time, however, the absolute necessity has been shown of having the lock (if there is to be one for the whole harbour) made of greater dimensions, on account of the great size of steamers now, than was ever before contemplated. But there are also practical advantages as regards despatch in having a large lock, where many vessels of ordinary size can be penned at one and the same time; and some information, with which the Committee have been furnished, as to the time occupied in locking, and the number of vessels which pass a lock in a tide, will be found in the Appendix.

In determining what is now best to be done, the Committee have had to bear in mind that they are bound to bring forward a plan that can be executed at a comparatively moderate expense—for there is a large amount of debt against the Harbour Trust; and, considering the nature of the trade of Aberdeen (a great proportion of it being confined to the coasting trade), the amount that must be raised by harbour dues on ships and cargoes, to meet the interest of the debt—the unavoidable yearly expenditure—and the outlay upon the new works, however limited may be the plan, will perhaps be thought more than it is wise to levy. Still there is reason to believe, that, if the burden be fairly apportioned, the trade of Aberdeen is in a condition to bear it, and in all probability may benefit by the outlay; and if the trade should go on increasing as hitherto, a reduction of the harbour dues might ere long be looked for. In another view of the matter, as the Trustees are no longer empowered to proceed with any new works, and the right to levy the present rates of dues would, together with the trust, expire with the present Act, and the harbour revert to the corporation, there can be no question that a definite plan of improvements ought now to be fixed upon, and a new Harbour Act applied for, such as may be in accordance with the wishes of the community.

To maintain vessels afloat in harbour appears to be attended with many advantages; and wherever the expense of docks has been incurred, with sufficient depth of water to approach them, the money has been universally allowed to be well laid out. Taking it for granted, therefore, that such an improvement is generally desired in Aberdeen, and will be thought generally beneficial, the Committee, after much consultation and deliberation, have resolved to recommend that the works for the purpose, upon the plan prepared by the resident engineer, Mr. Abernethy, are those which should be executed. The Committee have had before them several plans and a report by Mr. Alex. Gibb; also a plan and report by Mr. Wm. Leslie, a member of the Committee. The views expressed in all these plans and reports have received from the Committee the consideration to which they are well entitled; but either from the expensive nature of the plans, or because they offer no remarkable advantage without some countervailing objections, the Committee have preferred Mr. Abernethy's as affording the most suitable and extensive wet dock accommodation to be got for Aberdeen.

Mr. Abernethy follows Mr. Walker and Mr. Telford, in the point of converting the harbour into a wet dock. It is only the way in which that is to be done, and the methods proposed for executing the work, which are peculiar to his plan.

The Committee are aware that this plan will entail on the Harbour Funds a great expense for taking down and rebuilding walls that would serve sufficiently well as they are for a tidal harbour; but such are the advantages of the site of the dock, and it will afford such convenient accommodation to the principal branches of the trade of the port, that the Committee believe it will be found to be the one most for the interest of the community notwithstanding. To execute only part of the complete plan appears to be quite sufficient for the trade for a considerable time, as will be afterwards more particularly noticed.

Mr. Abernethy has been practically engaged, in the course of his professional experience, in various large harbour works in England; such, for instance, as the docks of Goole, where there is one of the largest locks in the kingdom; and he had prepared himself to report upon the Harbour of Aberdeen, by a particular examination, for some time, of the works already executed here; by making borings in the line of the new works proposed; by studying the plans and reports which have been made by former engineers; and by knowledge, acquired during his personal superintendence in Aberdeen, of the causes of complaint about the port, and the means of remedying them.

It had been suggested that the fishings on the Dee might be found to stand in the way of some plan that would turn out to be the best, as they have ever been said to do by the celebrated engineers who have formerly advised as to the improvement of the harbour, and it was proposed to ascertain to what amount any interference with the river would involve the Harbour Trust; but, as the Committee proceeded, it appeared that the subject to work upon is now in such a shape as to preclude any advantageous use of the fishing property for the present, and that, for some time to come, there is no occasion to go beyond the bounds of the present tidal harbour and embankments. The Committee

APPENDIX C.

ABERDEEN.

No. 199.
Report of Sub-Committee on the Improvement of the Harbour.

have, therefore, made no special inquiry as to the rights of the proprietors of the fishings, nor has anything been proposed in Mr. Abernethy's plan to affect their property. The state of the harbour funds was of itself sufficient to restrain the Committee from deliberating upon any more general and extended plan, for the present, than the one now recommended. But Mr. Abernethy has taken into consideration that additional accommodation will be sought for, and has sketched an extension accordingly, with other works at the entrance of the harbour, including a diversion of the lower part of the river. These things, though in accordance with, form no part of, the plan which it is proposed to take the authority of Parliament to execute.

There appears to be now no bar at the mouth of the harbour, and the soundings deepen speedily beyond the pierhead; but there is less water, by two feet, at some distance within the entrance channel, than there is farther within or without the same place. It is part of Mr. Abernethy's plan, which the Committee recommend to be executed, to remove the South Pier, and form a continuous sloping low wall from the point of the breakwater, westward, for about 700 yards. By means of these, and other works stated in Mr. Abernethy's report, for making a judicious use of the scouring powers of the river, the heavy yearly expense incurred for dredging may, in his opinion, be considerably lessened, and the navigation channel deepened and improved—a point of itself of essential importance, and absolutely necessary if full advantage is to be taken of the dock accommodation about to be provided. Mr. Abernethy anticipates that, besides deepening and straightening the channel, and keeping it so, these works will cause the inrun of the sea to be spent about the entrance, which, in easterly gales, since the removal of Abercromby's jetty, keeps the vessels, in the lower part of the harbour, ranging at their moorings. Vessels in the dock, however, would be beyond the influence of this occasional inconvenience; and, if it should continue to be troublesome, there are other means by which he thinks it may then, at no great expense, be got rid of.

By the publication, at the present time, of the several plans which have been submitted to the Committee, (among which will be found some designs of extended accommodation which had occurred to Mr. Walker, and which, on application being made to him, he readily placed at the disposal of the Sub-Committee,) the hints that are thrown out in them will be kept in mind, and may ultimately come to be of use to the port. These also lead the Committee to mention the likelihood of the embankment, on the south of the harbour, being required for harbour purposes; and the necessity, therefore, of retaining the ground as the property of the Trust—possession to be resumed whenever it may be required.

In explanation of the reasons which have induced the Committee to prefer the plan which they have now recommended, they have to state, that, from various quarters, the testimony as to the usefulness and economy, both in time and labour, and consequently money, of having the dock or docks as close and centrical to a town as they can possibly be, is strong and conclusive; so that, even though some considerable present sacrifice should be caused by the choice, the tidal harbour appears to be the best site of the *first* dock for Aberdeen. It is true the quays of the harbour have been built at long intervals of time, and not on any uniform plan; and unfortunately they will not, if allowed to stand as the walls of a dock, admit of having an equal and sufficient depth of water throughout the dock—nor are they thought generally sufficient to retain water locked in upon the ebbing of the tide.* But Mr. Abernethy and Mr. Alexander Gibb, having consulted together, have agreed that, by means of some new work, re-building a portion of the present walls, and securing others from leakage, as detailed in their estimate, there may be had, for the sum of 84,000*l.*, a lock with a triple set of gates, at the end of Waterloo Quay, of 250 feet long and 60 feet wide,† and a separate single pair of gates, of the same width, at the same place, enclosing a dock, when completed, of no less than 37 acres.

This estimate also includes some works before mentioned, recommended at the entrance of the harbour. The purposes contemplated in these will be found detailed in the report of Mr. Abernethy accompanying his plan. To assist in explaining his views, he caused a model of the harbour to be made, showing the various improvements he proposes, which has been exhibited in the engineer's office, and which the Committee have found very useful.

Mr. Walker, in his Report on the Port of Edinburgh, gives the following scale of the draft of vessels, by comparing which with the soundings marked on Mr. Abernethy's plan, a good notion may be formed of the nature and extent of accommodation which the harbour and dock of Aberdeen will be able to supply.

A vessel of 200 tons, it is said, draws	12 to 13 feet.
300	13 to 16 „
400	16 to 17½ „
500	17 to 18 „
600	18 to 19½ „
700	19 to 21 „

The greatest number of vessels ever in the harbour of Aberdeen at one time has been 155, and that occurred twelve or fourteen years ago. In 1841 the greatest number in the harbour at one

time was	119	of 18,274 tons.
And building at the same time	11	3,845 „
Together only	130 ships	22,119 tons.

Docks are usually reckoned to accommodate at the rate of ten ships to the acre. The Humber Dock at Hull is seven and a half acres, and holds seventy square-rigged vessels, with ample room for mooring them.

The dock at Aberdeen, on Mr. Abernethy's plan, will hold, say 300; and there appears to be no insurmountable difficulty in the way of gaining a greater depth of water between the piers than there is at present, if it were desirable to do so; and thus rendering the harbour fit for vessels of the largest class. But it is to be observed that the depths of water mentioned in Mr. Abernethy's Report are for ordinary spring tides, so that then only will a vessel of 600 tons be able to take Aberdeen harbour, and enter the dock or leave it, and not in the time of neap tides when there is always about four feet less water at the height of the tide. This shows the necessity of the walls of the dock being so

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* The leakage at Hull, from docks executed with the greatest care, is one-half to three-fourths of an inch per hour.

† The lock intended by Mr. Walker, opposite Church-street, was 220 × 60.

APPENDIX C.

ABERDEEN.

No. 199.
Report of Sub-Committee on the Improvement of the Harbour.

constructed as to prevent leakage, otherwise such vessels would ground in the dock at neap tides, and for the same reason it is necessary to be economical of lockage water.

The sewers which now run into the upper part of the harbour must, of necessity, be made to discharge somewhere not in the dock. The expense of the work recommended by Mr. Abernethy, in order to effect this object, is very considerable. If advantage is to be taken by the public of the new sewers, to be made at the expense of the harbour funds, it will be proper that some provision, as to making this property available for yielding a return to the harbour, should be embraced in the new Act; and some clause to reserve and secure to the harbour the benefit of any provisions in the General Bill for the Drainage of Towns, (which, it is said, has been in preparation as a government measure for some time,) if such works are provided to be made by any general assessment under that Bill. For the present, it is thought sufficient to run the whole sewers into one drain, in the course marked in the plan, to discharge at the end of Waterloo Quay. It would be desirable to have the exit farther removed from the lock, as some of the discharge may in this position cause a deposit in the entrance basin near the lock; but this can be but of trifling inconvenience, and ultimately, when found requisite, the drain may be continued into deeper water.

Although the amount of the estimate by Messrs. Abernethy and A. Gibb, before mentioned, would probably equal the means that will be at the disposal of the Harbour Trust for some time to come, the Committee recommend that power should be taken by the New Harbour Act to rebuild more of the quays, and gain a greater depth of water throughout the Dock, than has been contemplated in that estimate, whenever the Trustees should find such measures advisable, or even before completing the whole of the works specified in the estimate, if circumstances should render such a course proper.

When it was proposed that there should be but a single lock for the whole harbour of Aberdeen, the likelihood of great delay and annoyance was surmised by vessels crowding to enter or depart.* But Mr. Abernethy has wisely provided another passage in a single pair of gates alongside the lock, which can be thrown open as soon as the water is on a level outside and inside. By this passage vessels of a limited draft, but of any length whatever, may go out and into dock at high water; and, in the case of any accident to the lock, these gates are a prudent provision, and will be a great convenience at a time when repairs are required. Tugs having come into general use, they can be employed to bring vessels to the gates in a few minutes from any part of the harbour. The objections that would otherwise exist to one lock for so great an area of dock are thus entirely removed.

There may, perhaps, be some difference of opinion as to the propriety of laying out more money on the harbour at present, or as to the best plan to be adopted (seeing that the trade of Aberdeen, with the present rates of dues, and without a dock, has doubled in twenty years); but assuredly some plan should now be resolved upon, and whatever plan is authorised by the new Act should be adhered to, and the work executed with forethought and economy, whatever time it may take. With reference to this point, the Committee may observe that the Dundee Harbour Act is a perpetual Act, so that there is no interruption to the improvements going on at any time when funds are provided. The Trustees, by the Dundee Act, are expressly bound to lay aside, yearly, from the shore-dues collected, a certain per centage of the debt as a sinking fund, and can only spend the residue in improvements, whatever that may be—a provision which has been found, as the Committee are informed, of the greatest advantage to the Trust in every respect.

In conclusion, the Committee cannot omit the present opportunity of stating that, during the intercourse which they have had with Mr. Abernethy, they have been impressed with a confident belief that the works would be well and successfully executed under his superintendence. But in these observations they have no thought of recommending that any other plan but that of contracting for the works should ever be permitted, except in any special case which could not possibly be gone about in that manner.

In the course of completing his Plans and Report, Mr. Abernethy has had occasion to enter minutely into the particulars of the works to be executed, and can now, in a very short time, furnish specifications and plans of the whole in detail; and there are no doubt certain advantages in adopting the plan of the resident engineer—the preparations necessary for commencing the work, and the superintendence required in its progress, being all in the hands of the same person constantly upon the spot.

No. 200.

No. 200.
Customs-dues, 1805-46.

Receipt of Customs Duties at Aberdeen in the following years, viz.:—

Year.	£.	Year.	£.	Year.	£.
1805	16,023	1834	54,581	1841	78,205
1815	26,942	1835	53,879	1842	74,333
1825	50,839	1836	58,721	1843	77,491
1829	52,407	1837	65,365	1844	76,259
1831	53,320	1838	66,251	1845	75,972
1832	56,612	1839	71,892	1846	81,433
1833	57,879	1840	80,084		

WM. SAWYERS, *Collector.*
J. EXLEY, *Com.*

Customhouse, Aberdeen, January 8, 1847.

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* The greatest number of arrivals and sailings at Aberdeen has together been 53 in 24 hours. There is no record of the number in one tide.

No. 201.

Return of Income and Expenditure for the Years 1841–2–3.

INCOME.

Heads of Income.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Shore and harbour dues	16,318	5	9	16,643	8	2	23,195	2	11
Feu duties	411	12	5	411	12	5	411	12	5
Metage dues	1,006	17	10	1,301	18	9	1,776	8	11
Towage, per steam-boats "Paul Jones" and "Sea Horse"	1,418	18	2	879	1	8	..		
Rents	905	8	9	827	14	7	913	3	10
Ballast sold to shipping	1,277	18	2	1,248	0	3	1,492	16	0
Aberdeenshire canal	60	19	0	91	8	6	91	8	6
Manure sold	53	4	6	27	8	6	11	9	0
Treasurer of Aberdeen's proportion of expense for protection chains on Upper Quay	..			39	18	4	..		
Value of building stones on hand	253	4	0	..			..		
Cash per Duffus for taking down and re-building part of Waterloo Quay for launching a ship	..			16	1	8	..		
Old copper from sheds on the quay, sold to J. Blaikie and Sons	..			13	18	9	..		
Old iron, metal, and ropes sold	13	18	0	31	11	3	7	17	6
Use of ropes, under charge of the pilot	1	12	6	..			2	10	0
Interest, Aberdeen Town and County Bank	..			..			4	7	0
Interest, North of Scotland bank	..			..			3	4	11
Interest retained from property tax	..			..			185	7	5
Captain Pilot's Account.									
Captain Pilot's fees, pier light and flag dues	282	11	0	298	16	6	386	6	0
Patent Slip Account.									
Slip dues	351	16	6	289	0	7	301	13	9
Old iron and metal slip mounting sold to Commissioners of Fraserburgh Harbour	..			140	0	0	..		
Total . . . £.	22,356	1	7	22,259	19	11	28,783	8	2

EXPENDITURE.

Heads of Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Salaries to harbour superintendent, berth-master, and bridge-keeper, treasurer, and secretary	607	10	0	670	0	0	900	12	1½
Dredging the harbour, repairs, works, materials, and wages	2,128	1	1	2,878	9	6	2,039	7	8
Repairs of property, old works, pauls, buoys, roads, &c., including wages	758	2	8	760	1	4	397	6	11
Regent Bridge repairs, works and wages to labourers	174	11	0	128	12	6	187	15	4
Weights and measures, and repairs	64	8	0	64	18	3	70	12	0
Heaving ballast on board shipping	357	6	6	360	4	6	414	12	11
Charges on collecting shore dues, stationery, printing, insurance, and brass frames for office	357	13	3	386	1	9	621	0	6
Day patrol on the quays, for clothing and wages for two men	75	15	6	73	12	6	86	8	8
Incidental expenses	467	4	0	347	11	6	467	6	9½
Property-tax	..			..			262	6	7
Interest on bills, bonds, &c.	7,191	5	8	7,063	12	7	6,740	19	4
North pier repairs, including wages	155	8	0	2	8	0	59	10	1
Embanking the Inches, blacksmith's work, &c. 114*l.* 7*s.* 8*d.*; wages, 761*l.* 2*s.* 10*d.*	875	10	6	..			..		
Lime sheds on the Inches, for slater's work	10	16	10	8	5	3	16	2	11
Barges and boats, repairs and works	923	9	0	436	6	2	395	3	0
Utensils, repairs, materials, &c.	606	5	6	328	9	11	256	8	8
New life boat	155	0	1	74	3	0	6	14	5
Provost Blaikie's quay, extension of, repairs, wages, and including a new shed	1,070	18	6	188	6	11	3	12	0
Ditto paving	..			597	4	7	..		
Herring fishery for towing, advertisements, &c.	8	15	2	5	12	1	34	12	8
Building stones	464	7	3	..			..		
Sheds on the quays for repairs and works	..			84	4	2	6	6	10
Paving quay foot of Market-street	..			..			9	3	9
Ditto at Waterloo Quay	..			..			6	15	0
Regent Quay, enclosing ground and repairing roads at Old Lime Basin	..			..			3	13	4
Lamps on the quays, including repairs	..			12	5	0	..		
Protection chains on the Upper Quay	..			57	9	6	..		
Floating buoys in the harbour	..			..			139	9	1
Ropes under charge of the captain pilot	..			..			43	13	8
Leading lights for works, materials and wages	..			584	6	3	268	18	5
Breakwater, labourers' wages, and repairs	..			21	12	0	26	14	3
Towage of the port, bond, and agreement with James Robinson, owner of Samson and Dorothy steam boats	..			..			10	14	8
Railway to the Bents, works and materials and wages	400	17	3	787	15	1	1,083	15	7
Embanking ground to the Bents	..			..			725	18	10
New Harbour Act, for Parliamentary and other expenses	..			..			2,834	15	6½
Captain Pilot's Account.									
Salary to captain pilot and assistant	160	0	0	160	0	0	203	15	0
Rent	15	0	0	15	0	0	15	0	0
Sundries	94	7	0	21	6	1	46	5	6
Patent Slip Account.									
Salary and wages	115	7	0	59	19	0	83	9	10
Repairs and expenses	938	11	1	70	0	6	117	16	4
Metage Account.									
Salary, wages, and annuities	1,138	6	11	1,822	6	0	1,749	4	10
Sundry expenses	27	9	3	19	18	10	25	3	3
Tug Steam Boat Repairs.									
Paul Jones Sea Horse	2,501	0	6	1,996	11	2	114	5	5
Total . . . . £.	21,843	7	1	19,586	13	11	20,491	16	4

Rates of Dues, registered tonnage per British ships, 1*d.* and 1½*d.* per ton; Foreign, 1*s.* 2*d.* per ton.

JAMES RIDDEL, } *Treasurers.*
ALEXANDER REID,

Debt due on the 1st January, 1846, 186,676*l.*

APPENDIX C.

BODDAM.

No. 202.
Gray, on the Harbours at Boddam.

BODDAM.

No. 202

Extract of a Letter from the PROVOST *of* PETERHEAD, *relative to Boddam Harbour.*

Peterhead, December 28, 1846.

THE estate of Boddam belonged to my late friend and partner, Bailie Robertson, of Peterhead; and I took charge of it for him. The harbours there were planned by me chiefly for the accommodation of the fishermen; but they might be adapted for carrying on a considerable trade. I have access to the Paliamentary plan, of which I shall send a copy. William Smith, architect in Aberdeen, was the Parliamentary engineer; Messrs. Macdonald and Leslie are the architects; but these harbours remain nearly in the same state as I left them, except the obtaining of an Act of Parliament authorising duties to be levied. I have another plan, and if it is different from the Parliamentary one, I shall also send a copy of it. I am not aware that any report was made by Mr. Smith, although I think he must have done so when the Act of 1845 was applied for. James Brehuer, Esq., advocate, Aberdeen, is factor for Lord Aberdeen, and has the charge of Boddam.

Continuation of Letter.

December 29, 1846

I now send you a sketch of plan, taken from the Parliamentary plan of the harbour of Boddam; as it does not differ in anything material from the original plan, I shall not trouble you with a copy of it. I notice that Mr. Smith carries the return kant so as to close up a natural entrance, which I intended to preserve. Mr. Macdonald, of Messrs. Macdonald and Leslie, mentioned to me, some time ago, that it was under consideration whether this natural mouth should not be preserved. The harbours are difficult to take in stormy weather, but are safe when entered; and there is considerable depth of water at the mouth of them. The North Harbour was excavated from the rock, and this excavation may be continued to a considerable extent. A harbour might be formed, or rather the small harbour at the fishing village might be extended, and have deep water at all times of the tide, by connecting the rocks as I have marked in pencil; but the north harbour is the best, as it is protected by the rocks outside of it.

As you can easily have access to the statistical account of the parish of Peterhead, I would beg leave to refer you to it for some information in regard to the fishing village of Boddam.

I enclose a plan and sections of the quarries of Sterling-hill, the greater part of which now belongs to Lord Aberdeen, and a printed description of these quarries. I need not add, that I shall be happy to afford you any further information in my power. I am sure Mr. Brehner will be ready to furnish you with information brought down to the present time.

I am, &c.,
ROD. GRAY.

No. 203.

Evidence taken on the 26th September, 1846.

PETERHEAD.

No. 203.

Present:—The PROVOST; JAMES MCLAREN, Esq., præses to the Governors of the Merchant Maiden Hospital of Edinburgh; JAMES BURGESS, Esq., Treasurer to the said Governors; JAMES GIFFORD and WILLIAM GIRDWOOD, Esquires, two of the said Governors; WALTER JOLLIE, Esq., their Agent; and Messrs. ALEXANDER ANDERSON; ALEXANDER ROBERTSON; WILLIAM ALEXANDER; WILLIAM VOLLUM; JOHN YOUNG; WILLIAM SIMPSON; ADAM ARBUTHNOT; JAMES HUTCHISON; WILLIAM LAWRENCE; ALEXANDER CATTO; DAVID EWAN, and CHARLES TOD; twelve of the Harbour Trustees; Mr. DAVID STEVENSON, Civil Engineer; Captain JAMES LOURIE, and Messrs. ALEXANDER SOUTTER, Captain, Pilot, and Berthing Muster, and ANDREW BOYD, Clerk.

Mr. RODERICK GRAY examined.

Is provost of Peterhead, and præses of the trustees of the harbours, in the absence of the præses of the governors of the Merchant Maiden Hospital of Edinburgh, founded by the company of Merchants of the city of Edinburgh, and Mary Erskine. These harbours, since 1807, have been managed under Acts of Parliament. The first Act commenced on the first day of September, 1807, and was to continue for 21 years, and from thence to the end of the then next session of Parliament. The second Act, which is perpetual, and under which the harbours are now managed, is the 7th and 8th Geo. IV., cap. 34. The ex-officio trustees are the præses of the governors of the said hospital, or the proprietor of the estate of Peterhead for the time. The baron bailie, or baillies of the town of Peterhead for the time being when there shall happen to be more than one. The factor for the governors of the said hospital, resident in the town of Peterhead for the time, and the treasurer of the town of Peterhead, and sixteen trustees, to be elected. The ex-officio trustees are, in their order of nomination, appointed to preside at the meetings of the trustees. In consequence of the Parliamentary Burgh Reform Act, 3rd and 4th William IV., cap. 77, the provost, magistrates, and council appoint two of their number as trustees of the harbours, in room of the baron baillie and town treasurer, who occupy the same place, and have the same privileges as the baron baillie and treasurer formerly possessed. Including the ex-officio trustees, there are 20, 15 of whom are at present shipowners. Five are a quorum. In consequence of the contract reserved to the governors of the said hospital by the Acts of Parliament, no works of extent and importance are commenced without communicating with them, and obtaining their approval, which in no case has been refused. The ordinary business and repairs are carried on by the local trustees, and a state of the revenue and expenditure is transmitted annually to the said governors for their information. The harbours belonged to the Earl Marischal, afterwards to the York Building Company, and were purchased, along with the estate of Peterhead, by the said governors. Previous to the passing of the Acts of Parliament, the harbours were regulated; 1st. by a contract entered into between the Earl Marischal and the feuars of Peterhead, in 1593; and 2nd, in virtue of the said contract, and another entered into between the governors of the said hospital and the feuars of Peterhead, dated the 7th and 16th days of December, 1774, and recorded in the general register of sasines, the 22nd day of the same month and year. Four of the trustees go out of office annually, and are not re-eligible for the space of one year. The services of the trustees are entirely gratuitous. They hold about 25 meetings annually. The pilots, from 25 to 30 in number, are licensed by the trustees in January, annually, on the report of the pilot master, and after examination by the trustees. The old haven, near to the Ronheads, a part of the town formerly inhabited by fishermen, was built in terms of the agreement contained in the contract with the Earl Marischal. The south and west piers of the present south harbour were planned by Mr. Smeaton in 1773, and were completed in 1781, at a cost of 3256*l*. In 1807, the late Mr. Rennie gave a plan and report in regard to Peterhead Harbour, and, among other things, recommended to excavate and enlarge the harbour, and to extend the return kant of the west pier, both of which were carried into effect at a cost of 13,800*l*.; and this harbour was thus extended to about 6¼ imperial acres, and became capable of accommodating from 100 to 120 vessels. In consequence of the increase of the trade, especially of the whalefishery, the south harbour was incapable of accommodating the ships belonging to the port and the other vessels resorting to it, and there was not sufficient depth of water to admit the whalefishing ships on their return from the fishery. Under these circumstances the trustees applied to Government, and the late Mr. Thomas Telford, civil engineer, was consulted, and the north harbour built at an expense of 25,194*l*.; but a north pier being found necessary, has since been completed at an expense of 4,800*l*. These sums are exclusive of the expense of building quays and making excavations in the north harbour. The total expenditure on both harbours since 1797 amounts to about 67,020*l*. The area of the north harbour is 10¾ acres. The last mentioned Act gives power to borrow 60,000*l*. on the security of the dues. The debt has been of various amounts—at present it is 33,888*l*., for which interest is paid at the rate of 4 per cent. The income for the year, ending in March, 1846, was 3756*l*. 13*s*. 11*d*. The engineers at present consulted by the trustees are Messrs. Robert Stevenson and Sons, Edinburgh, who have been requested to meet the Tidal Commissioners to prepare a Report on the harbours, and to give designs for their improvement; and also for a harbour of refuge, which is much wanted on this part of the coast, and for the erection of which Peterhead affords great facilities; but as this matter is of national importance, the trustees have requested Messrs. Stevenson to call into consultation William Cubitt, Esq., civil engineer, London. The south harbour is dry at low water—excavation of rock from the bottom has being going on occasionally, and the deposits of mud from the washings of the streets are removed generally once in two years. No mud, sand, or gravel is washed into the harbours from the sea. The cut between the harbours, recommended by all engineers, has not been executed, because it is necessary, in order to render it generally useful, that the south harbour and the inner north harbour should be deepened. The rock in the bottom of the harbours is too hard to be dredged, and requires to be excavated. Cranes have been erected on the quays. Many wind-bound vessels take refuge here; as many as 232 ships of 14,085 tons did so during the past year. About 100 Archangel, American, and Baltic ships call for orders. Besides the whale fishing, the herring fishing has latterly much increased; 400 boats came in last season, so that there is great want of further accommodation. The chief want is to render Peterhead a harbour of refuge for vessels requiring shelter from storms, and

Appendix C.

Peterhead.

No. 203.

Evidence taken on the 26th September, 1846.

during contrary winds, for which its position at the eastern promontory of Scotland peculiarly points it out: such a harbour in this locality would be the greatest benefit that could be conferred on the shipping that pass along the east coast of Scotland. To attain this object, an additional depth of water, and an extension of the harbours, with further protection to the North Harbour are necessary.

The witness referred the Commissioners to a memorial drawn up by him at the request of the harbour trustees, and under their revisal and sanction, as containing further details with respect to the harbours, and their peculiar adaptation to be formed into harbours of refuge.

Mr. A. Boyd, clerk to the trustees since 1822, submitted the minute book, the treasurer's and the collector's account books, and the letter book.

Commissioner.—As far as a cursory inspection will enable me to judge, the harbour books appear to be in good order, and to be carefully kept.

Alex. Soutter examined.—Has been 12 years harbour-master at Peterhead, and 36 years at sea. His duty is to berth vessels that come into the harbours; he is also pilot-master, receives his orders from the trustees, who support him in his duty. No ballast is allowed to be thrown over in the harbours. Boards with the harbour and pilot regulations are exhibited in two places on the quay. The length of the south quay of the south harbour is 480 feet; its breadth 42 feet; length of west quay, 653 feet; the width of entrance is 90 feet; total length of quays of the north harbour, 2220 feet; width of entrance, 100 feet. The south harbour dries at low-water springs. The north harbour, from the graving dock northwards, is afloat, and has 8 feet depth at the pier heads. Spring-tides rise 11½ to 12 feet, neaps 6 feet. Has known as many as 145 vessels in the south harbour at one time in 1829, with a continuance of strong southerly winds. The greatest evil at Peterhead is the want of a cut between the two harbours. From want of this, has known vessels detained days and sometimes weeks. The north harbour is uneasy to lie in. If the cut were made, all would seek shelter in the south harbour. There was a passage for the sea formerly at high-water, between the two harbours, but the mound, called the Sand Bridge, was formed to connect the islands with the town; but if the cut is made, it would be of little value unless the south harbour were deepened. The bottom is of rock, partially decomposed, and must be quarried out to be removed. There is one graving dock on the east side of north harbour; it is 130 feet long, by 56 wide; width of entrance, 34 feet. The rocks project to the westward of the entrance of the south harbour, and would be better taken away. Yet a vessel can round to in the bay, and shoot in without great difficulty. A standing red light is shown on the west pier head of the south harbour, which may be seen 3½ miles distant.

Mr. Walter Jollie, W.S., the agent for the governors of the Merchant Maiden Hospital of Edinburgh, stated:—That the truth of the able memorial on the harbours of Peterhead, drawn up in March, 1844, by the provost and trustees of the harbour, was confirmed by every day's experience; a large saving to the country would accrue from a good asylum harbour being formed at Peterhead, capable of being taken at all times of tide; the shipping of the whole of the east coast of Scotland would be in favour of it. Numerous are the vessels that would gladly seek shelter in it. There are now 14 Greenland ships belonging to the port; and about 150 vessels, going foreign, call in annually. The number of wind-bound vessels, with their tonnage, which have entered the harbours of Peterhead during the last twelve years, are as follows:—

Years.	Ships.	Tons.	Years.	Ships.	Tons.
1834	280	17,303	1840	217	11,358
1835	298	15,808	1841	211	10,989
1836	304	15,520	1842	207	11,840
1837	258	13,267	1843	180	9,518
1838	200	9,690	1844	170	9,316
1839	206	10,934	1845	232	14,085

Thus showing the great value of a refuge harbour at this eastern extreme of the coast of Scotland.

Captain James Lawrie examined.—Has been acquainted with the harbour of Peterhead since 1808, and for 30 years has been master of a vessel. At high-water spring-tides a vessel drawing 16½ feet can come into the north harbour, and one of 13½ feet draft into the south harbour. A very awkward rock, called the Maw Craig, lies just off the entrance, and should be removed; many vessels have touched on it, and occasionally vessels are wrecked. Peterhead is a favourite harbour with shipping. Vessels can put into Peterhead when they cannot get shelter in the Moray Firth, or go to the southward. The chief thing wanted is to deepen the south harbour, and make a communication between the two harbours, which might be done by an easy cut. In the north harbour the water must be quieted. Vessels strike on the ground and tear away from their fastenings. Booms are wanted, or some other device, to still the harbour. The graving dock is a great advantage; but a patent slip is much wanted. The sea is so heavy at times that he has seen a chain cable washed off the platform of the quay, and yet the parapet wall is 15 feet high. He has seen large stones thrown up to the top of the wall. Improvements are much wanted, but if these were carried out, Peterhead would be one of the best harbours on the east coast of Scotland.

Mr. Vollum examined.—A breakwater is much wanted to protect the north harbour. When there is any swell, it is hardly possible to hold a vessel at her moorings in the north harbour. The south harbour should be enlarged, as much more accommodation is wanted, and the traffic would increase as accommodation is afforded.

Captain Anderson examined.—Would recommend piers being carried further out into deep water. Something also is wanted to shelter the entrance of the north harbour. The canal or cut between the two harbours is absolutely essential for accommodation. Agrees in what has been stated by other witnesses, but would repeat that the harbour must be deepened, as vessels are often neaped.

Mr. D. Stevenson, C.E., examined.—Knows Peterhead. His father gave a plan for its improvement, and has himself, in conjunction with his father and brother, been consulted at various times, as to works that have been from time to time carried on at the harbour. Conceives it to be a place admirably adapted for the establishment of a harbour of refuge, either on a small or a large scale. The east coast of Scotland, between the Moray Firth and the Firth of Forth, is much frequented by shipping, and is much in want of a harbour of refuge. Knows no place on that coast affording such facilities for the establishment of such a harbour as Peterhead, and that for the following reasons:—First, in a general point of view, from its position on the coast, situated nearly midway between the

APPENDIX C.

PETERHEAD.

No. 203.
Evidence taken on the 26th September, 1846.

Firths of Moray and Forth at the most eastern, and therefore, the turning point of the coast; and secondly, *locally*, from the following advantageous circumstances:—The coast at Peterhead assumes the form of a promontory, having to the south the deeply indented bay of Peterhead, and to the north a smaller bay or creek. At the extremity of this promontory are situated two islands called Keith and Greenhill (now united with the mainland by an artificial mound); and the harbours of Peterhead are formed in the natural creeks, or havens, which lie between these islands and the mainland. These islands, therefore, serve a twofold object, for not only do they act as a breakwater, protecting the area of the harbours, but by projecting into the sea, they, to a certain extent, tend to throw the pier heads of the harbours into shelter. These creeks are further naturally deep, the pier heads of the north harbour being in a depth of 9 feet at low water, while the same depth exists at a few yards distance from those of the south harbour. A further advantage consists in the formation of the coast at this place, the whole being rock, and thus there is no danger of the harbour being filled with sand, which has occurred, to a greater or less extent, in nearly all the harbours on the east coast of Scotland

The present condition of the harbours may be briefly stated as follows:—The south harbour is dry at low water of spring-tides, and has an area of about seven acres, while the north harbour, which has about nine feet at low water at the pier-heads, is only partially dry at low-water, and has an area of about 10 acres.

The capabilities of improvement, as already stated, are great, and improvements could be effected either on a small or a large scale. If on a small scale, they ought to consist in the excavation of the area of the harbours, and in the formation of a cut or canal through the narrow neck of land which at present separates them. Were these operations carried out, the extent of accommodation would be much increased, and a very great advantage would be attained, by affording to shipping leaving the port the choice of a north or south exit. These improvements could be carried out without interfering materially with the trade of the port, as one harbour might be kept in use while the other was being improved. Nor would these smaller improvements interfere in the least, but rather might be considered as a part of the more extended plan referred to, which would consist of covering breakwaters projected from the shores, so as to enclose such a sheet of water for the waves to expend as would admit of the adoption of more direct entrances from the sea than those of the present harbours. Abundance of the finest materials for these purposes is to be had in the immediate neighbourhood. Has had considerable experience in designing and executing harbour works. Has paid a great deal of attention to this department of engineering. Knows most of the harbours of Great Britain, Ireland, France, and North America, and does not know of any place possessing, on the whole, greater natural advantages for the establishment of a refuge harbour than Peterhead. Considers that, on the coast from the Moray Firth to the Firth of Forth, there is a great want of a refuge harbour, and is confident that the improvement of Peterhead would be hailed with unqualified approbation by the shipping frequenting the eastern shores of Scotland.

(*Adjourned.*)

No 204.
Return to Order of House of Commons of 9th August, 1844.

No. 204.

Return by the Trustees of the Harbours of Peterhead, of the titles of the several Acts of Parliament under which they have acted, and now act, and copies of all Maps of the Harbours of Peterhead in their possession, and of all Reports made by Engineers or other officers, respecting the said Harbours, made in compliance with an Order of the House of Commons, dated August 9th, 1844.

Peterhead, March 5, 1845.

Titles of the Acts of Parliament:—

I. An Act for deepening, enlarging, maintaining, and improving the Harbour of Peterhead, in the county of Aberdeen, passed in the 47th year of the reign of King George the Third. Endurance 21 years from 1st September, 1807.

II. An Act for more effectually enlarging and improving the Harbours of Peterhead, in the county of Aberdeen, 7th and 8th Geo. IV. cap. 34. A copy of this Act is herewith transmitted.

Copies of Maps:—

I. Draught of the Town and Sea Coast about Peterhead, with Plan of the Harbour of Peterhead, 1739.

II. Plan, Section, and Elevation of a Project for a new Pier to cover the Mouth of the South Harbour of Peterhead, against the effects of southerly storms, within which an East India Ship or a Frigate might safely ride, even at low water, by Lieut. John Marr, one of His Majesty's Engineers, 1773.

III. Plan of the Harbour of Peterhead, with a project for improving the same by building a New Pier, by Lieut. John Marr, one of His Majesty's Engineers, 1773.

Note.—This and the preceding plan, section, and elevation, are those referred to in Mr. Marr's, Letters and Reports, Nos. 4 and 5 of Reports.

IV. Plan of the Town and Harbour of Peterhead, with the works proposed for enlarging and for the improvement of the said Harbour, by Mr. John Rennie, Civil Engineer, 14th February, 1806.

V. Plan of the Peterhead Harbour, with elevations and sections by Mr. Rennie. 14th February, 1806.

Note.—This and the preceding plan are referred to in Mr. Rennie's Report, No. 3 of Appendix to printed Memorial.

VI. Plan of the North Bay of Peterhead, with the proposed improvements, 9th November, 1806.

VII. Plan of the Harbour of Peterhead, showing its improvement, agreeably to a design of Mr. Robert Stevenson, civil engineer, 1826.

Note.—This is the plan referred to in Mr. Stevenson's report and estimate, No. 11 of Reports.

VIII. Plan of the Harbours of Peterhead, 1844, and map of the adjoining coast. No. 8 of Appendix to printed Memorial. No. 1 of Reports.

APPENDIX C.

PETERHEAD.

No. 204.
Return to Order of House of Commons of 9th August, 1847.

Reports by Engineers and other Officers :—

I. Memorial in regard to the Harbours of Peterhead, in the county of Aberdeen, North Britain; their proposed improvement and extension; and their fitness for being formed into Harbours of Refuge, with Appendix annexed, containing—

I.—1. Recommendation of the Royal Boroughs for a contribution for repairing the Harbour of Peterhead. 5th July, 1735.
2. Attestation by the shipmasters of Leith in favour of the Harbours of Peterhead. 6th February, 1738.
3. Declaration by the merchants anent the Harbours of Peterhead. 7th February, 1738.
4. Act of the Town Council of Edinburgh, appointing a voluntary contribution for the Harbours of Peterhead. 14th February, 1739.

II.—Report. The Burghs of Aberdeen and Banff upon the Peterhead Harbour. 1773.

III.—Report and Estimate of the expense of enlarging and improving the Harbour of Peterhead, agreeable to a plan and sections thereof, designed by John Rennie, Esq., of London, civil engineer. 1806.

IV.—Report by the Trustees for the improvement of Peterhead Harbour, under an Act passed in the 47th year of His Majesty's reign, "for deepening, enlarging, maintaining, and improving the Harbour of Peterhead in the county of Aberdeen." 25th March, 1812.

V.—Memorial and Petition of the Governors of the Maiden Hospital, founded by the Company of Merchants of the City of Edinburgh, and Mary Erskine, proprietors and superiors of the town of Peterhead, and the Trustees of the Harbours of Peterhead, on behalf of themselves and the other principal inhabitants and traders of the town of Peterhead, and the commercial part of the community, and the public in general, for the interest they had in the application, to the Honourable the Commissioners appointed by Parliament for applying certain balances arising from the forfeited estates in Scotland, towards making Canals, Harbours, and other public works there. 1815.

VI.—Lists showing comparative utility of Peterhead and Ramsgate Harbours, for seven years after the improvement of each, respectively, 1780–86, 1816–23.

VII.—State showing the number of wind-bound vessels, with their tonnage, which have entered the Harbours of Peterhead for refuge, from 1st January, 1834, to 1st January, 1844.

VIII.—Plan of the North and South Harbours of Peterhead, 1844, and Map of the adjoining coast for about 8 miles.

II. Copy Act of the Privy Council anent the Harbours of Peterhead. 26th February, 1705.

III. Copy Letter and Report by Mr. John Smeaton, civil engineer, relative to the improvement of the Harbours. 19th December, 1772.

IV. Copy Letter and Report, by Lieut. John Marr, engineer, 9th June, 1773, with reference to his plans for improving the Harbours. Nos. 1 and 2 of copies of plans herewith transmitted.

V. Copy Letter and Report by Lieut. Marr, 18th January, 1774, also with reference to his said plans.

VI. Copy Excerpts from the Reports of the Commissioners for Roads and Bridges in the Highlands of Scotland, relating to the harbours of Peterhead.

VII. Copy Report by the Commissioners of His Majesty's Court of Exchequer at Edinburgh, legalizing the quays of the North Harbour of Peterhead. 13th January, 1823.

VIII. Copy Report by Mr. Robert Stevenson, civil engineer, relative to the extension of one of the Quays in the North Harbour of Peterhead. 20th May, 1824.

IX. Copy of Memorial to Parliament in regard to the Harbours of Peterhead. October, 1824.

X. Copy Report, by Mr. Robert Stevenson, civil engineer, on the improvement and extension of the North Harbour of Peterhead. 31st March, 1826.

XI. Copy Report, by Mr. Robert Stevenson, civil engineer, on the improvement and extension of the said harbour, and of relative estimates of the expense, including a cut or canal of communication between the harbours. 7th November, 1826.

Note.—The plan referred to in this Report is No. 7 of Plans.

Complaints made to the Trustees of the Defects of the Harbours :—

The trustees are not possessed of any written complaints of the defects of the harbours. These complaints have, however, been very general on the part of the masters and owners of vessels frequenting the harbours more particularly with respect to the deficiency in the depth of water in the south harbour, and in the upper part of the north harbour; and also to the want of sufficient protection in the north harbour, and of a cut of communication between the north and south harbours.

ROD. GRAY, *Preses of the Harbour of Peterhead.*
ANDREW BOYD, *Clerk to said Trustees.*

Peterhead, March 5, 1845.

No. 205.

Report by J. SMEATON, Esq., C.E., *relating to the Peterhead Harbour.*

No. 205.
Smeaton, on the Harbour.

SIR, *Yorkshire, December* 19, 1772.

HAVING now in course fully considered what is before me concerning the harbour of Peterhead, I am of opinion that the design marked out in green upon the plan delivered to me and now redelivered, is most likely of rendering the purposes of that harbour more safe and quiet in south easterly-winds, which I understand from Captain Kydd's information, as well as from the shape and position of the adjacent coast, are the only winds that can annoy this harbour; some advantage however may, I think, be gained by making both the piers form a curve towards their heads, with the concave-sides outwards, because in that position the south pier will tend to throw off the seas in south-easterly winds towards the south; and in part to destroy their inclination to turn round the head, and in like manner the sea recoiling from the rocks on the N.W. side of the entry, which I understand from Captain Kydd, in

APPENDIX C.

PETERHEAD.

No. 205.
Smeaton, on the Harbour.

conversation, was one of the greatest causes of annoyance to the harbour, will, by the like curve of the pier, be not only thrown outwards from the harbour's mouth, but also, meeting the north side of the south head in an oblique direction, will greatly tend altogether to throw the sea outward. I think therefore, upon the whole, an opening of 80 feet clear may be admitted between the heads, which will render the harbour of more easy access; but if it is found by experience that less than the present opening, which by the scale appears to be about one chain, or 74 feet, will be sufficient, it will undoubtedly follow that the narrower the entry the more quiet the vessels will lie when in. The breadth of the south pier is proposed in the memorial laid before me, to be 50 feet, and the west pier 40, which is very proper; but as they are sketched in the plan, they are not above half that breadth, and therefore do not show the true position in which things will come together. In order therefore to explain myself fully concerning the curvature of the pier, and show the true position in which things will stand, I have herewith sent you a sketch of what is most likely to answer.

From the general map of the kingdom, and the particular plan before me of the coast adjacent to Peterhead, it seems that the harbour of Peterhead is very critically situated, and therefore that the making the best possible harbour there will be of great utility. It seems also that it is capable of considerable improvement by making a communication with the north harbour; but as this will be a work subsequent to that of rendering the harbour secure, and as I cannot be so complete a judge of the situation from any plan as if I had actually been upon the place, I shall content myself with my intimation, not doubting but when the first and main point is secured, that the importance of the object, will produce the means of such improvements as shall appear to be of consequence.

I am &c.,
J. SMEATON.

P.S. It seems to me that by shaping the heads in the manner specified, they will not only tend to keep out the seas from the harbour's mouth, but greatly tend to facilitate the entry of vessels into the harbour, and also give them a good berth to go in contrary, but moderate winds.

No. 207.

Report and Estimate by JOHN RENNIE, Esq., *of the Expense of Enlarging and Improving the Harbour of Peterhead, agreeable to a plan and sections thereof, designed by him in* 1806.

No. 206.
Rennie's Report and Estimate for improving the Harbour.

London, February 14, 1846.

PETERHEAD is situated in 57° 30′ north latitude, 1° 32′ west longitude, and is the most easterly promontory of land in Scotland. The harbour is formed by two small islands lying off the main land, but these have been joined to it by a road or causeway which divides it into two, and forms a north and south harbour. The southern harbour is defended from the sea by a pier at the southern end of the island, called Keith Inch, and the entrance to the harbour is at the western end of the pier, very close in by the shore. There is a pier on the west side close by the town, and nearly at right angles to the former, having a return head of about twenty yards in length, and opening inward, so that it leaves a space between and the south pier of twenty-six or twenty-seven yards wide, which is the entrance to the harbour.

The Bay of Peterhead extends for about half a mile westward of the entrance, and Salthouse Head lies something more than three-fourths of a mile south-west of the harbour; south of Salthouse Head is another bay, about the same depth from thence as the former, and this again is bounded on the south by Boddom Head, which is about a mile and a quarter south of Salthouse Head, between and which lies Invernettie Bay. This latter head lies about S.S.W. from Peterhead, and distant about two miles. In either of these bays, therefore, vessels may be completely sheltered from all winds coming from points west of S.S.W., and N.N.E.; but as the shores are very bold and rocky, they are dangerous to anchor in, with stormy weather and easterly winds. In westerly and northerly winds, the harbour is easy of access, but in south-easterly winds and stormy weather, it is not only difficult, if not impracticable, to enter, but even unsafe within. The waves in these winds break many miles to seaward, in ten and twelve fathoms water, and roll along the south pier with great impetuosity, breaking on the rocky side of the bay to the westward of the harbour mouth, and recoiling into it, so as to occasion great agitation within; vessels, therefore, in attempting to enter, are often wrecked; and those within are so tossed about as to occasion damage. Sheltered, therefore, as the harbour seems to be, by the construction of the piers, yet, in fact, it has not been found to be so.

A harbour should be constructed with an entrance as accessible as possible from the sea, because in stormy weather vessels approaching it are often, by the ground swell, rendered very difficult to manage; and when they are obliged to work to round nearly at right angles to their course, as they must do to enter this harbour, it its extremely difficult to prevent them from receiving damage. The exposure of the mouth to the recoil of the waves from the rocky shore west of it is also a great obstruction, so that it appears to me, on the whole, this harbour has been injudiciously constructed, both for the safety of vessels entering and for their security when in the harbour. Experience has proved that entrances land-locked, as that at Peterhead is, instead of gaining the object in view, namely, of quieting the waves when they rebound from the adjoining shore, often increase them; and therefore it is better to give such a form to the piers that guard the harbour, to prevent the entrance of the reflected waves, than to landlock it, so as to expose the mouth to them; had the south pier been constructed with a returned kant, such as is represented by the dotted lines, 1, 2; and had another pier been built from the western side, like that represented by the dotted lines 3, 4; although the entrance would have been apparently more exposed to the sea, yet it would have been much easier of access for vessels, and been more quiet within. Such a construction would now be both difficult and inconvenient to adopt, and therefore may at present be unadvisable; I say at present, because should the northern harbour be improved, these can be done without much inconvenience. It strikes me that the most proper plan to be adopted now will be to extend the return pier or jetty-head about 60 feet in the same direction, nearly as the present jetty, and to take away all the abrupt walls and projections from the eastern side of the harbour, opposite thereto, and for some small distance within the line of its direction, as far as the south wing of the ballast quay, slanting off the shore of Keith Inch Island, gently and regularly, so that the recoiling waves may spend their force thereon, in place of running up the harbour, and agitating the whole of it. Such an extention may be done without much inconvenience to the shipping, and will greatly quiet the harbour. This jetty

APPENDIX C.

PETERHEAD.

No. 206.
Rennie's Report and Estimate for improving the Harbour.

will cost about 500*l*. The slanting beach will be useful at times in assisting to stop a vessel's way in entering the harbour; and from the experience I have had, is much better calculated to destroy the force of the waves than any other construction I have seen.

The next material object of consideration is that of deeping the harbour, which at present cannot well accommodate vessels drawing more than 12 feet water in spring tides, but in neaps is not sufficient. To render this harbour more extensively useful, it would be advisable to have 17 or 18 feet water over the greatest part of its bottom, and particularly along the west quay.

By Mr. James Arbuthnot's soundings, there appear to be 18 feet water at the entrance, at the top of an ordinary spring tide, but only 14 at the eastern extremity of the jetty of the west pier; from thence it gradually diminishes to the head or north end of the harbour; now, were about four feet or four feet and a half taken off the bottom over the whole harbour, except where the slanting beach is proposed, this would give all the depth that could for ordinary purposes of trade be wanted. The amount of this would probably be about 30,000 cubic yards, the expense of which, I apprehend, would cost little short of 4*s*. per cubic yard, amounting to 6000*l*.,—contingencies about of 1300*l*., making a total of 7300*l*.

The mode of performing this kind of work will be different, according to the difference of situation. Those places where the tide ebbs from the surface and continues so for some time, may be done by blasting, or by loosening the stones with quarrying tools in the usual manner; but in those parts were the tide seldom leaves the bottom, and in others but for a short time, different methods must be resorted to. The best of all would be enclosing large spaces by coffer-dams, and working at all times of tide by quarrying tools or blasting, as might best suit; but in some situations this would be inconvenient, as the dams would be in the way of vessels going into and coming out of the harbour; in such situations perhaps the simplest and most expeditious mode would be to use cast-iron cylinders of seven or eight feet diameter, having strong canvas fixed to the lower flanch, which might be kept to the bottom by bags of sand in places where there was but little agitation, but where there is much, an outer cylinder might be sunk thereon to keep them in their situations; or where the rock is not very hard, it might be done by the same means as the bottom of the harbour of Toulon was done (where some of their principal dry docks were sunk in caissons), this was by mounting on a lighter or punt machinery to raise two very heavy iron stampers, having steel cutters at their lower ends; these were raised and let fall thereon by machinery. A small steam-engine of three or four horse power would work them better than the method that was put in practice there; I have been told that this machine at Toulon performed its purpose very well. The stones so loosened might then be taken up by the same kind of vessels and machinery as Mr. James Arbuthnot, junior, has practised so successfully, and with so much credit to himself, in other works about the harbour.

When the improvements I have mentioned are carried into execution, the present or south harbour will be found capable of affording great additional convenience to the shipping, and will enable the merchants of Peterhead to increase their trade; but these improvements are far short of what the harbour is capable of. Were the northern bay or harbour properly protected, and were a communication formed between the south and north harbours, the harbour of Peterhead would be the completest of any in Scotland, perhaps of any in the island. The extent, however, to which the improvement should be carried will in a great measure depend on the object for which it is intended. I consider myself as viewing the subject merely for the purposes of trade; but should ever this be looked to as a public object, and as for a station for men-of-war and ships of the line, it must be taken up on a much more extended scale, and probably in this case the plan would be very different from what I mean to propose. What is here proposed, however, would sufficiently answer all the objects of merchantmen, and sloops-of-war; perhaps even frigates might be stationed here, and make use of it with safety; but beyond this I do not consider the present plan of sufficient magnitude to afford the accommodation that a large fleet of ships of the line would require.

I propose that the north harbour shall be sheltered from the sea by means of two piers—the one which I propose to be the largest should depart from the Green Island, a little short of its northern extremity, and is represented in the plan by the figures 5, 6, 7: the eastern kant is about 172 yards long; the western kant, about 66 yards long. The sounding at low water, at the western extremity of the pier, is about six fathoms, and that adjoining the island about three and a half fathoms. The foundation of this pier must be formed pierre perdue—that is, large stones sunk in the sea—which will take a slope something like the dotted lines round the pier; these stones should be laid to the height of low-water mark, and to have a flat top on which the pier is to be built. The stones of which I propose the base to be formed should be of as large dimensions as can conveniently be procured, for the seas in northerly winds will beat furiously against them; and the interstices between filled with those of a smaller dimension, which by the action of the seas will wedge in amongst the others, and form one compact body that will resist the storms. The outside wall of the pier itself, I propose to be built with large stones well jointed, and if laid in puzzolano mortar, so much the better, for if once the sea were to make any impression upon it, the damage would soon become very great.

The piers of Scarborough, which are not more exposed to the seas than this will be, are built with very large rough stones, some of them about twenty-five tons in weight, but from the interstices being large (the stones not being dressed), I have known several of them thrown down from the piers with storms. If, however, they are jointed, and laid in regular courses, and in puzzolano mortar, the sea does not easily make any breach, and therefore stone of much less dimensions will suffice. I propose the pier to be built with an out and inside wall, and to be filled between with rubble from the different quarries from whence the stones for the other works are to be taken.

On the western side of the harbour I propose another, as represented by the figures 8, 9, 10. The head or slanting kant to be about 76 yards long, the other to be 83 yards long; the distance of the head of this from the former I propose to be 70 yards, but as the base of the eastern pier will extend for about 25 yards beyond the head of the pier itself, the next opening will only be about 45 yards; however, as the water is deep, vessels of a moderate size may come nearer to the eastern pier than 22 yards.

The direction given to the heads of these piers is such as will render the entrance easy to take in stormy weather, and they will reflect the waves in such a manner as to prevent most of them from getting into the harbour; and those few which do get in will spend their fury on the flat shelving shore abreast of the roanheads, so that most of that part where the deep water is will be completely sheltered, and vessels will ride in safety under the shelter of the great eastern pier. The western being built entirely on rock, which is dry at low-water, the foundations, and indeed the whole pier, will be easily executed. It will also form an excellent accommodation for small vessels, which may load or discharge

APPENDIX C.

PETERHEAD.

No. 206.
Rennie's Report and Estimate for improving the Harbour.

their cargoes here; and indeed a breast-quay may be built part of the way to Front-street, which will afford an additional accommodation for the shipping, with convenient wharfs and quays.

The next material object is the opening of a passage between the south and north harbours. This might be done by a narrow canal, in the direction 11, 12, just wide enough for two ships to pass, having a pair of gates at each end; but the place is so admirably adapted to a small wet dock that I could not resist the temptation of representing one on the plan in this place. If a narrow cut, say about 40 feet wide, is made from the south harbour across Bridge-street, having a swing bridge upon it for the purposes of carriages, and just beyond this a pair of gates, pointing northward, with an opening 30 feet wide, and a similar cut at the north end, with gates pointing southward a wet dock might be conveniently formed between these gates, of about 580 feet long and 225 feet wide, which would cover about three acres with water. The materials which would come out of the dock would be sufficient to raise a broad and convenient quay all round. I propose this dock to have about 17 feet depth of water at ordinary spring tides; but it may be made as much deeper as shall be judged advantageous. Here vessels would constantly ride afloat alongside the quays, and if proper and convenient cranes and warehouses were to be built on its sides a very great deal of business might be done. Thirty sail of vessels of the average size of about 180 tons might conveniently load or discharge at a time, and as they would be done expeditiously, there might be a great quantity of business done in the course of a year. The situation is such that vessels might either go into or out of it, from the north or south harbour, according as the wind may suit; and as the Bay of Inverugie extends to the westward on the north side of the harbour as much as that of Peterhead Bay on the south side, vessels will always have room enough to work, either in going in or coming out. A more convenient harbour can scarcely, therefore, be imagined than this will prove to be.

In respect to the expense, it will no doubt be great, as will appear by inspecting the estimates, and probably much greater than can be borne by the town of Peterhead and country about it; but the benefits of such a harbour as this will be, if executed as I have proposed, will not be confined to the town and country round Peterhead; it is a national object, whether considered in a commercial point of view or a station for sloops of war and frigates, and, if made on a proper scale, for ships of the line. In the first case, every vessel making a northern voyage, or south, or going or coming from the East country, when overtaken by storms or contrary winds, would always be able to find a safe rendezvous here.

As a look-out station for frigates and sloops of war, should an enemy come on the coast, it possesses every advantage that could be wished. Vessels may enter it in all weathers and all winds. If judged necessary to keep ships of the line there, a harbour might be made probably on a different, and certainly a much more extended, plan than that I have proposed. Its situation is most desirable. In whatever point of view, therefore, it is considered, it appears to me a most important situation for a harbour, and well deserving of public aid, as well as subscriptions from those interested in the commerce of the country. Large, therefore, as the expense appears to be, it is small when put in competition with the advantages the trade of the country would derive from it; and, therefore, I am of opinion, that were its advantages properly represented, the inhabitants might not despair of obtaining money, sooner or later, to carry the whole of this plan into execution.

Should the wet dock I have represented be considered too small, the situation admits of great enlargement, and indeed there are places adjoining where a wet dock of any size may be formed.

Ship-building may be carried to a great extent; there is room for forming ship-yards at the head of both harbours, and dry docks may be constructed, having their entrance from the wet dock, and emptying their water into the tide-way, or along the east side of the present harbour, or the new north harbour, as shall be found most convenient, and their number and size may be extended as the trade of the place shall demand. It would, however, be extending this Report to a greater length than appears to me necessary to make designs for everything of this sort. If the general outlines of the plan I have laid down shall be carried into execution, particular designs may be made for dry docks, &c.

In respect to the estimates, I have put such prices to the different articles as seems to me equal to the expense; it is possible, however, some of them may be high, and others too low, but these depend so much on the goodness of the quarries, on the facility with which workmen can be had, &c, that correctness cannot be expected—they may, however, be raised or lowered, as shall be found suitable; but I apprehend they will be found, on the whole, tolerably correct.

JOHN RENNIE.

London, Feb. 14, 1806.

Estimate of the Expense of Extending the Jetty of the Western Pier of Peterhead 60 *Feet, and deepening the Harbour from* 4 *to* 4½ *Feet.*

Jetty	£500	0	0
30,000 cubic yards of stuff to be removed from the bottom of the harbour, at 4*s.*	6000	0	0
Contingencies, 20 per cent. on the whole	1300	0	0
	£7800	0	0

Estimate of the Expense of making a Wet Dock of about Three Acres, and having 17 *Feet Water at ordinary Spring Tides, between the South and North Harbours.*

To excavating for the dock, rock and all included—66,500 cubic yards, at 3*s.*	£9,975	0	0
To excavating for the entrances, 4100 cubic yards, at 4*s.*	820	0	0
To 5500 cubic yards of hammer-dressed stone work in quay-wall, at 10*s.*	2,750	0	0
To 2100 ditto in wings and at entrance, at 15*s.*	1,575	0	0
To gates and coffer-dams	2,100	0	0
To 400 cubic yards of rough rubble wall, at 5*s.*	100	0	0
To drawbridge at Bridge-street	450	0	0
To levelling the quays and pumping water	1,600	0	0
To contingencies	2,905	0	0
	£22,275	0	0

APPENDIX C.

PETERHEAD.

No. 206.
Rennie's Report and Estimate for improving the Harbour.

Estimate of the Expense of constructing an East Pier at the North Harbour, agreeable to the Plan.

To 55,500 cubic yards of stone or pierre perdue to form a base for the Pier, with allowance for loss, &c., at 6*s*.	£16,500	0	0
To 6,100 cubic yards of strong rough masonry in large hammer-dressed blocks, at 18*s*.	5,490	0	0
To 1,100 cubic yards of cut stone masonry in parapet, at 21*s*.	1,155	0	0
To 21,300 cubic feet of paving, at 1*s*.	1,065	0	0
To 12,600 cubic yards of rubble, filling, and rubbish between the walls, at 1*s*. 6*d*.	945	0	0
To contingencies	5,031	0	0
	£30,186	0	0

Western Pier of North Harbour.

To 2750 cubic yards of strong rough masonry, in pier hammer-dressed blocks, at 17*s*.	£2337	10	0
To 550 ditto in parapet cut stone, at 21*s*.	577	10	0
To 11,800 cubic feet of paving, at 1*s*.	590	0	0
To 5200 cubic yards of rubble, filling, and rubbish between the walls, at 1*s*. 6*d*.	390	0	0
To contingencies	779	0	0
	£4674	0	0

No. 207.

Report by the Trustees for the Improvement of Peterhead Harbour, under an Act passed in the Forty-seventh year of his Majesty's reign, "for deepening, enlarging, maintaining, and improving the Harbour of Peterhead, in the County of Aberdeen."

March 25, 1812.

No. 207.
Report by the Harbour Trustees on the Harbour.

IN the year 1806 John Rennie. Esq., civil engineer, having made an estimate of the expense of extending the jetty of the west pier, and removing 30,000 cubic yards of rock and other stuff from the bottom of the harbour of Peterhead, amounting to 7,800*l*., the trustees, in order to enable them to carry this estimate into execution, made application for aid to the Parliamentary Commissioners for Highland Roads and Bridges, who, in consequence of the public utility of the undertaking, agreed to defray one-half of the estimated expense, and a contract was entered into between the Commissioners and the trustees, the latter having agreed to become contractors for the execution of the improvements specified in the estimate.

In the month of December 1810 the trustees completed the works contracted for, which have been since examined by the engineer of the Commissioners, and upon his report the Commissioners have been pleased to announce that they consider the contract to have been fulfilled by the trustees. It now remains only to state the benefits that have resulted from the works performed, which they have no doubt will be found to be more than adequate to the expense incurred.

Previous to the late operations the harbour was only capable of containing from fifty to sixty sail of small vessels, and now will contain from 100 to 120 sail of a larger draft of water in complete safety. Thus, for six weeks during the storms of last autumn not less than 100 sail of vessels of various descriptions found perfect safety, when in all probability, as they could not have fetched any other harbour on this coast, a great number of them would have been totally lost. What renders Peterhead Harbour of peculiar importance is its situation, and the shelter it affords, not only to the vessels belonging to Peterhead and those in the coasting trade, but to all vessels, whether British or Foreign, which chance to be on this coast during the storms of winter, from the facility with which they can run into it.

Owing to the difficulty of excavating the rock under water, and the necessity of employing a considerable number of men at low tides at an extra expense, the trustees have expended in the execution of the contract a considerable sum beyond the estimated expense; and, in consequence of the excavations, it has been found necessary to rebuild part of the west quay and to extend it about 200 yards, which has been done; and, in order to render the harbour as useful and commodious as possible, the trustees purchased some ground on the east side, which has been since excavated, and a quay built extending betwixt the Ballast Quay and the Sand Bridge.

The extension of the jetty of the west pier, and the sloping beach opposite the harbour-mouth, have been productive of very beneficial effects, and have completely realized the purpose for which they were intended, to prevent the agitation of the water in the harbour.

The rock and other stuff taken from the bottom of the harbour have been deposited in the direction of the small island called Greenhill, and which is now by this management connected with the shore. The new embankment is defended from the violence of the sea by a bulwark which the Trustees have erected while the other works were in progress, and this embankment forms part of the great plan for making an extensive north harbour, which might be a rendezvous for sloops of war and transports, and is allowed by engineers of the first rank to be capable of being formed into the most extensive and useful harbour on the east coast of Scotland. The expense of finishing this harbour will be such as to render its execution impracticable unless undertaken at the expense and under the direction of Government. The trustees, however, cannot pass any opportunity which presents itself of bringing this useful undertaking into public view.

The Trustees may further be permitted to mention, in enumerating the advantages derived from the late excavations in the South Harbour, the case of his Majesty's ship, the *Pylades*, in the storms of autumn 1811. This ship, when her chain cables gave way, while she was riding in the bay of Peterhead, was by the exertions of her crew and of the inhabitants of the place, got into the harbour's mouth, where she remained in safety; and that she could not have been got in or saved, had it not been for the additional depth of water occasioned by the excavations performed under the contract with the Commissioners.

In short, the trustees are enabled to state with great confidence, that the public have derived and will continue to derive, benefits from the late improvements of Peterhead Harbour, by far more than adequate

APPENDIX C.

PETERHEAD.

No. 207.
Report by the Harbour Trustees on the Harbour.

to the sum expended; at the same time they beg to state that the South Harbour of Peterhead is capable of many improvements of the greatest importance, and that a still greater depth of water would be of essential service to the public, as ships could then sail at the very lowest neaps, when a fair wind offered.

Given under the hands of the trustees, at Peterhead, this 25th of March, 1812.

ROBERT ROBERTSON, and 10 others.

No. 208.

No. 208.
Petition of the Governors of the Maiden Hospital to the Commissioners of Highland Roads, &c.

To the Honourable the Commissioners appointed by Parliament for applying certain balances arising from the Forfeited Estates in Scotland towards making Canals, Harbours, and other public works there,—

The humble Memorial and Petition of the Governors of the Maiden Hospital, founded by the Company of Merchants of the City of Edinburgh and Mary Erskine, Proprietors and Superiors of the Town of Peterhead, on behalf of themselves and the other principal inhabitants and traders of the Town of Peterhead, and the commercial part of the community, and the public in general, for the interest they have in the present application.

1815.

PETERHEAD is situated in 57° 30′ north latitude, and 1° 32′ west longitude. It is the most eastern promontory of land in Scotland, and its harbours are equally distant from the Moray Frith and Frith of Forth. These harbours are formed by nature, and protected by two small islands, and are divided from each other by a road or causeway which forms a communication between the islands and the mainland.

At a very early period the situation and usefulness of the harbours of Peterhead attracted public attention. Accordingly, in the year 1705, an Act of the Scottish Privy Council was obtained for a voluntary contribution "within all the parish churches of the three Lothians and bewest the Forth," for building and repairing the harbours of Peterhead, and in the year 1729 the Convention of Royal Burghs authorised a voluntary contribution through all the Royal Burghs in Scotland for the same purpose. Neither of these contributions, however, for reasons which it is unnecessary now to mention, took place. But in the year 1739 the Royal Burghs again authorised a voluntary contribution to be made for improving these harbours, and which was made accordingly.

The South Harbour is protected by one of the small islands which have been mentioned, called Keith Inch on the east, and by two excellent piers, built of granite, according to a design and plan by the late Mr. Smeaton, about the year 1770, on the south and west. Previous to the erection of these piers (the expense of which was defrayed partly by a grant from Government, and partly by contributions from the inhabitants), the improvements of this harbour had been very inconsiderable; for the contributions received from the Royal Burghs had been requisite to keep the old bulwarks in repair, without affording the means for augmenting the dimensions of the harbour. After the piers designed by Mr. Smeaton had been executed, the harbour began to be enlarged by excavating progressively in the inside of the piers, until at last the harbour became capable of containing from 50 to 60 sail of vessels.

It having been found, however, that the harbour was still too small to contain the vessels frequenting it from almost every part of Europe, the memorialists, in the year 1807, submitted an application to your Honourable Board, accompanied by a report and estimate by Mr. Rennie, praying for an aid towards excavating 30,000 cubic yards of rock and other stuff from its bottom. The estimate for executing this work amounted to 7,800*l*.; and your Honourable Board having agreed to advance one moiety of this sum, the other moiety was raised by voluntary contributions from your memorialists and others; and the memorialists becoming the contractors for the work, it was completed to the satisfaction of your Honourable Board.

Here the memorialists beg leave to state that over and above the sum of 7,800*l*. which has been mentioned, they expended an additional sum of 6,000*l*. in further excavations, in building piers, and in forming an embankment and bulwark, so as to make a communication with the Greenhill Island, so that since the year 1807 the memorialists have expended the sum of 13,800*l*. upon the improvement of this harbour, including the aid of 3,900*l*. obtained from your Honourable Board. For an enumeration of the advantages which the public has derived from these improvements, the memorialists beg leave to refer to the Report of your Honourable Board, of date the 25th day of March, 1812, and printed in the Appendix of the Report of your Honourable Board, presented to Parliament.

The total number of vessels of various descriptions now belonging to the port of Peterhead is 78, the burden of which is upwards 9,000 tons. As a fishing station, Peterhead, as is known to your Honours, has long been conspicuous; and it is scarcely necessary to allude to the great quantities of fish which are sent from it to the London market, or to the advantages which might be derived from a regular establishment of a herring-fishery there. With respect to the Greenland Fishery, which the Legislature has so warmly and so wisely encouraged, as of so much importance to the country in general, Peterhead possesses considerable advantage from its experienced fishermen, and from its being the first land made on their return by the ships in that trade. Eight vessels belonging to, and fitted out at, Peterhead are this year employed in the Greenland Fishery.

Notwithstanding the additional accommodation procured in the South Harbour from the recent improvements of it, and the additional depth of water thereby obtained, its extent is still too limited to accommodate the shipping resorting to it and those seeking its shelter; and it cannot be extended farther in any direction without purchasing private property at a very high rate. In these circumstances the memorialists have been induced to turn their attention to the North Harbour.

It has been the opinion of several able engineers that an extensive and commodious harbour might be built in the North Bay of Peterhead, where there is at present a small creek which is termed the North Harbour, and that were a communication formed between the North and South Harbours, the harbours of Peterhead would be rendered the completest in Scotland, perhaps of any in the Island.

Various plans for protecting the North Bay and forming such a harbour have been proposed, but most of them are upon too great a scale of expense to be undertaken by the memorialists or any individuals. It is certain, however, that a plan upon a limited scale could be executed at a comparatively moderate expense, and from which important advantages would result, not more to the interests of the town and port of Peterhead than to the interests of the shipping of the country at large.

APPENDIX C.

PETERHEAD.

No. 208.
Petition of the Governors of the Maiden Hospital to the Commissioners of Highland Roads, &c.

Nature has so far protected the North Bay by a ridge of rocks called the Borehead on the north, and by the island already mentioned, the Greenhill, on the south. The plan, therefore, which the memorialists have at present in contemplation is to construct a pier or breakwater projecting from the Greenhill, and extending 400 or 500 feet into the bay; to form a dry dock in the Greenhill, and to build a wharf extending along the face of the embankment already executed between the South Harbour and the Greenhill.

Were this plan executed, the North Harbour of Peterhead would be made capable of containing a much greater number of vessels than the South Harbour, and would have even an advantage over that harbour, insofar as it would possess a greater depth of water—a depth which for a considerable space within the pier or breakwater would be from twenty to twenty-six feet at medium spring tides, and so sufficient at all times to admit merchant ships of any burden, and what would be of infinite importance to shipping in general, vessels might then, with any wind, either go out or come in to the harbour of Peterhead with the greatest safety. Besides this, farther advantage would attend the execution of this plan; other necessary wharfs and excavations could be executed progressively, as the situation of the country and the trade of the port required, out of the revenues arising from the increasing rates and duties of the harbour, which would arise from the increasing resort of vessels to it, and which are destined exclusively for its improvement.

The memorialists herewith transmit to the Honourable Commissioners a plan of the Town and Harbour of Peterhead, with some delineations upon it, which give a general idea of the works proposed, and they humbly hope that the great public utility of these works will be apparent to the Honourable Commissioners; and as the memorialists are willing to contribute 10,000*l.*, as one-half of the probable expense of carrying them into execution, they most earnestly pray the aid of the Honourable Board, either to advance the other half of the expense, or to grant the memorialists, as trustees under the aforesaid Act of Parliament, an assignment to a sum of equal value out of the Leith Harbour debt; or, if it shall appear to the Honourable Commissioners to be more expedient to give the memorialists a grant of such yearly sum as in ten or fifteen years shall amount to 10,000*l.* out of the above fund, the memorialists shall previously advance an equal sum in each of these years, to be applied progressively in executing the works alluded to.

Should the Honourable Commissioners be pleased to listen to the prayer of this memorial, the memorialists humbly solicit that they may authorise such engineer as they shall think proper to visit the premises, to report on the works proposed, and suggest the most eligible mode of carrying the same into execution, and also to give a plan and specification of the same, and an estimate of the probable expense of executing them.

No. 209.

Memorial from Peterhead, concerning Damage occasioned by a Storm in October last.

January 31, 1820.

No. 209.
Memorial concerning Damage occasioned by Storm.

To the Honourable the Commissioners appointed by Parliament for applying certain Balances arising from the Forfeited Estates in Scotland towards making Canals, Harbours, and other Public Works there.—

The humble **MEMORIAL** and **PETITION** of ROBERT ROBERTSON, Esquire, of Boddam, chief magistrate of Peterhead, and the other individuals who subscribe to this Petition, Trustees, under an Act of the 47th of the King, for deepening, enlarging, maintaining, and improving the Harbour of Peterhead, in the county of Aberdeen, and Contractors for building a new North Harbour there,—

SHEWETH,

That in the course of the year 1816 the petitioners and others interested in the trade and shipping of Peterhead presented a memorial and petition to your honourable Board, in reference to certain projected improvements on the harbours of Peterhead, and stating *inter alia* that an opinion had been given by several able engineers that an extensive and commodious harbour might be built on the North Bay of Peterhead, where there was a small creek termed the North Harbour, and that, by forming a communication between this and the south harbour, the harbour of Peterhead would be rendered the most complete in Scotland, perhaps of any in the island:

That the petitioners detailed various plans which had been proposed for building this harbour, and stated their readiness to contribute one-half of the expense which such undertaking would require; and they earnestly prayed that your honourable Board would give them your assistance in providing for the other half, by making them a grant to that extent out of the funds intrusted by the wisdom of Parliament to your management:

That your honourable Board, from a conviction of the public utility of the proposed works, were pleased to listen to the application of the petitioners, and in the course of the year 1816 you remitted to Thomas Telford, Esq., civil engineer, to visit the harbour of Peterhead, and to report on the alterations proposed to be made thereon; and Mr. Telford having accordingly made a report approving of the same, your honourable Board were pleased to make the petitioners a grant of 10,000*l.* towards carrying the works into execution, and which was one moiety of the estimated expense, according to the plan and specification made out by Mr. Telford:

That, on matters being thus arranged, your petitioners, in the course of the year 1818, entered into a contract with your honourable Board for executing the proposed works, agreeable to the plan and specification thereof made by Mr. Telford; and they employed Mr. John Gibb, civil engineer, to take the immediate charge of the works under Mr. Telford, who had been repeatedly employed in other works carried on under the countenance of your honourable Board, and in whose professional abilities Mr. Telford had full confidence:

That the work commenced in the spring of the year 1818; and having been visited by Mr. Telford towards the close of that year, that eminent engineer was pleased to express his entire satisfaction with the manner in which the work had been executed, and the progress which had been made in it:

That, from the very favourable state of the weather throughout the winter of 1818, the petitioners were induced to use every exertion in proceeding with their undertaking; and Mr. Telford having again visited the works in the course of last autumn, and again expressed his entire satisfaction with

APPENDIX C.

PETERHEAD.

No. 209.
Memorial concerning Damage occasioned by Storm.

their progress and execution, the petitioners had the satisfaction to find that they had brought them to that state of forwardness which enabled the petitioners, under the conditions of the contract, to enter upon the receipt of the moiety of the expense which your honourable Board had agreed to advance to them:

That, at the period of Mr. Telford's last visit, the breakwater and wharf, the most important part of the projected works, had been carried into the sea to the extent laid down in the original plan, but they were still in a very unfinished state, and it had become necessary to secure them against the winter storms with which the coast of Peterhead is frequently visited; and this the workmen had commenced doing, by placing large masses of stone and other materials upon the top of the building:

That in the beginning of October last, whilst the work was in this situation, the gales of wind from the north-east, which are frequent on this coast towards the close of the season, set in with unusual violence, and continued to increase till the 23rd of that month; on that day the storm became a complete hurricane, which proved extremely injurious to the works in which the petitioners were engaged, the sea running higher and with greater fury than had been known for many years preceding, and striking directly upon the unfinished parts of the works; notwithstanding this, however, it was not until the morning of the 24th that any material damage was occasioned to them: then they began to give way about the middle, and the sea continued to rage with unabated fury, the breach which had been made was gradually increased until the whole of that part of the work was nearly levelled with the low-water mark:

That, the whole force of the sea having been impelled during the continuance of this tremendous storm against the seaward side of the unfinished building, the injury which it sustained was in consequence very considerable: with a view to ascertain precisely its extent, and for the better information of Mr. Telford, the petitioners, immediately on the storm having abated, caused Mr. Gibb to examine the work and draw up a report as to the nature and extent of the damage which had been sustained; and they requested him at the same time to make out a sketch or plan in reference to it. Upon this examination it appeared that the upper half of the breakwater had been carried by the violence of the sea completely over the ashlar front wall into the intended basin, but that no part of the stones had been carried seaward, nor had the foundation under low water been materially injured, from which Mr. Gibb very justly concluded that the damage had been wholly effected by the extraordinary violence of the sea driving the immense mass of materials before it, and that little or no injury had been caused by the receding wave:

That, in consequence of the very great damage which had in this way been occasioned to their works, it became a matter of important consideration with the petitioners what measures were necessary to be adopted in order to prevent a similar occurrence; and Mr. Gibb's attention having been particularly called to this, he has accordingly stated his ideas on these points very accurately in the report drawn up by him on the subject, and he there gives it as his opinion, "that a new foundation should be laid for the wharf, on the inside of the mast as it now extends, and that the slope on the outside of the breakwater should commence at or near the extremity of the present foundation, and be carried up increasing in proportion as the breakwater extended, which would give a slope at the most exposed part of about three and a half horizontal to one perpendicular, in place of one and a half, which is the slope at which the part that is now thrown down was built. Besides an increased slope there will be space left for a stronger parapet, which I would also propose to enlarge in proportion as the work approaches the most exposed point. I would likewise recommend building this parapet in the form of an arch, which would in some measure economise the work, and, by its form offering less resistance to the sea, tend greatly to the security of the superstructure."

In the event of this change of form being approved of, Mr. Gibb goes on in his report to say, "I would also advise that the return kant, from the line of the inner wharf of the breakwater, should not be so acute as formerly proposed, but that it should be built nearly in the line I have laid down on the plan, which line would not diminish the protection originally intended to be given to the interior of the harbour by this kant, nor materially decrease the depth of water into the entrance." And he adds, "that by building the wharf on the inside of the materials as they have now been laid by the storm, and commencing the outside at or near the extremity of the present foundation, the increased slope which is proposed to be given to this work will place the platform and main body of the breakwater more within the shelter of the Roan Head, and what is commonly called the North Head Rocks, than if (with a view of giving additional security to the superstructure) a strong shoeing were extended beyond the present basement of the breakwater. I may also add that I am also of opinion that the increased slope which is proposed to be given to the outside of the breakwater, will tend greatly to spend the tremendous seas which roll into the North Bay, and thereby render the entrance into the harbour more accessible in stormy weather."

To this Report Mr. Gibb subjoins an estimate of the expense which he considers will be required to execute the alterations and improvements proposed by him, and this expense he calculates to amount to, independent of all casualties, about 3384*l.* 0*s.* 8*d.* sterling.

That the petitioners are satisfied that the alterations proposed by Mr. Gibb have become necessary under the existing circumstances, and they confidently trust that they will render the works in question fully capable of withstanding any future extraordinary violence of the sea; and a copy of Mr. Gibb's Report and Plan having been transmitted by the petitioners to Mr. Talford, they have the satisfaction to state, that he has also given them his decided and unqualified approbation; and he at the same time observes that the change of plan with regard to the breakwater, to which the storm had unavoidably led, might on the whole prove advantageous, from having shown the outside slope at which the stones would lie:

That, from the circumstances which have now been detailed, the petitioners trust that it will appear to your honourable Board, that the unfortunate interruption which has been caused to their works is attributable solely to the extreme violence of the storm, to which the petitioners have alluded, and that your honourable Board will be satisfied that the petitioners had adopted every measure in their power to carry on their work with energy, and to execute it in the most substantial manner; and that during the whole of its progress they were aided by the able advice of Mr. Telford, who has paid the utmost attention to its execution, and by the active and immediate superintendence of Mr. Gibb. That the consequence of this unlooked-for occurrence has been, as your honourable Board will have seen, to render necessary an alteration of the plan of execution originally intended, the expense of which, as has been mentioned, is estimated by Mr. Gibb, independent of all casualties, at no less than 3384*l.* 0*s.* 8*d.* sterling.

APPENDIX C.

PETERHEAD.

No. 209.
Memorial concerning Damage occasioned by Storm.

That in these circumstances, and considering the great public utility of the works in question, the very great sum which the petitioners have already contributed towards their execution, and the unlooked-for and unexpected occurrence which has so greatly increased the original estimate which they had formed of their expense, the petitioners venture again to solicit the aid of your honourable Board towards raising the additional sum now required; and they trust they will not be considered as presuming too much on your known liberality, when they extend this request to a moiety of the estimated sum mentioned in Mr. Gibb's report.

May it therefore please your honourable Board to take this petition into your consideration, and to grant to the petitioners one-half of the foresaid estimated expense of 3384*l.* 0*s.* 8*d.* sterling, or to do otherwise in the premises as to your honourable Board may seem just and expedient.

And your petitioners shall ever pray, &c.,

ROBERT ROBERTSON,
ROD. GRAY, and 15 others.

No. 210.

The Report of ROBERT STEVENSON, Esq., C.E., *on Peterhead Harbour.*

Edinburgh, May 20, 1824.

No. 210.
Stevenson, on the Harbour.

AT the desire of the Trustees, the reporter, with as little delay as possible, has procured a survey with sections of the North Harbour of Peterhead, made by Mr. Whyte, land surveyor. From these the accompanying sketch plan has been delineated, for the purpose of making a design by which this compartment of the harbour may be rendered more safe and commodious for the berthage of shipping. The improvement more immediately suggested by this design is to extend the new pier 104 yards in a north-eastern direction, by a kant or off-set formed at an angle of 160 degrees, as shown in red colour upon the accompanying plan.

That the harbour may be easily accessible for ships of large dimensions in all states of the weather, the entrance is of an obvious and simple form, while the distance between the pier-heads is to be not less than 50 yards in width. This operation alone will effect a considerable improvement upon the quiescent state of the interior waters of the harbour; at a further period it is further intended to erect a cross wall or pier in some of the situations already contemplated. By this means the whole area, including about 10 English acres, will be formed into two compartments, with an entrance for shipping, which, if found necessary, may be fitted with boom-gates, so as to give the interior harbour all the properties of a wet-dock at high water.

The extension of the new pier, as delineated with red colour upon the plan, is, however, all that the reporter has more immediately in view. The workmanship of this extended pier should be executed in a style similar in all respects to the most substantial masonry of the other piers. The Trustees will therefore be at no loss to form such a practical estimate of the expense of this operation as will enable them to draw up an outline of their future proceedings.

When time permits, the reporter will complete his design with the necessary specifications and an estimate of the expense, in reference to the ulterior and more extended measures to which his attention has been directed,

ROBERT STEVENSON.

To the Trustees for the Harbours of Peterhead.

No. 211.

The Report of ROBERT STEVENSON, Esq., C.E., *on the North Harbour at Peterhead.*

Edinburgh, March 31, 1826.

No. 211.
Stevenson, on the North Harbour.

AGREEABLY to instructions from the Trustees of Peterhead Harbour, the reporter has considered the unprotected and inefficient state of the north harbour; and having procured a survey of its area, he reports as follows in reference to the accompanying plan of this date.

Peterhead forms the eastern foreland of Scotland, and holds a central position between the great commercial firths of Forth and Moray. It has accordingly become a much frequented rendezvous for shipping. From small beginnings therefore, at a period not much more than half a century ago, this has become a populous town and a great shipping port. Its harbour dues also, which did not then amount to more than *l.* per annum, now yield *l.*

The first step toward the prosperity of Peterhead was the formation of what is now called the south harbour, including an area of upwards of six acres. But from the general increase of shipping on the coast and great resort to this place, its extension became indispensably necessary. A few years since, a new harbour was accordingly projected with an entrance from the north; which, in so far as it has proceeded, has been found highly beneficial, and is thus ultimately to afford the means of entering and leaving the harbour in all directions of the wind. The new harbour is also connected with a graving dock for the repairs of ships, and has so far been formed by piers and quays of the aggregate length of upwards of 600 yards, terminating seaward in a depth equal to 8 feet at low water of ordinary spring tides, and 19 feet at high water. It is therefore capable of receiving the largest merchant vessels and the smaller classes of His Majesty's ships of war. Owing, however, to the want of a covering pier on the western side, the full benefit of the new harbour cannot be obtained; and vessels at their moorings in the interior have occasionally sustained damage by being exposed to the uncontrolled surge of the sea.

With a view to obviate this in some measure, the Trustees have formed a temporary breakwater within the area of the harbour; and the reporter is now to suggest what he conceives to be necessary for completing this compartment of the plan, and also to lay down the place of junction or communication between the south and north harbours.

By the accompanying plan the reporter proposes that the new quay of the north harbour should be

APPENDIX C.

PETERHEAD.

No. 211.
Stevenson, on the North Harbour.

extended about 150 yards by two kants toward the north-east, so as to meet the covering line of the east pier, and thereby to include an area of upwards of 10 acres, commanding a depth of water as before mentioned of from 8 to 19 feet. If it were proposed to project the new quay seaward in a straight line, a most valuable portion of the area of the harbour would thus be excluded. It would also shorten the seaward kant in such a manner as neither to exclude the sea from the harbour, nor afford it sufficient expanse in the interior.

But, to take a different view of the subject, and instead of extending the new quay, a pier may be projected from Port Hendry in the first instance, as shown in the plan. The north harbour would thus contain an area of about 16½ acres. But this would require the erection of a pier of about 285 yards in length, or 135 yards more than the extension of the new quay, and thereby cost almost double the expense.

By this modified plan it will be observed, that the great body of the sea falls past the entrance of the harbour into the bay to the westward, and the reporter anticipates that the disturbing force of the sea which occasionally must find its way into the interior will be inconsiderable. Were the compartment connected with Port Hendry included, as shown by the dotted lines upon the plan, it would afford an additional expanse to the water, and render the interior more quiescent. It must, however, be admitted that piers situated so much apart as those, would, in the connected state of the town, be very inconvenient for communicating with the shipping. Under all circumstances, therefore, the reporter recommends the extension of the new quay, which he estimates in a general way at 9070*l.*, especially as it will be perfectly practicable, with very little alteration, at any future period to form the harbour upon the more extended plan by including Port Hendry, and forming the whole into one area of 16½ acres.

With regard to the communication between the south and north harbours, the reporter proposes to cut a canal or passage on the eastern side of the ship-carpenters' building-yard, as shown in the plan, and to place a draw or swivel bridge upon it, in order to preserve the thoroughfare between the different parts of the harbour and town. In the present stage of the business, however, the reporter does not consider it necessary to enter more into detail, or to specify the proposed works.

ROBERT STEVENSON.

To the Trustees for the Harbour of Peterhead.

No. 212.

Report of ROBERT STEVENSON, Esq., C.E., *on the best means of improving Peterhead Harbour.*

No. 212.
Stevenson, on improving the Harbour.

Edinburgh, November 7, 1826.

PETERHEAD, on the coast of Aberdeenshire, holds a central position between the great commercial Firths of Forth and Moray, and forms a turning point in the navigation of these much-frequented shores. It is also immediately connected with a bay which affords excellent anchorage, and, with the promontory of Buchanness, the eastern foreland of Scotland, which of late has been made a lighthouse station. The improvement of Peterhead Harbour as a rendezvous for windbound ships becomes therefore an object of public and even of national importance, being often calculated to save the repetition of a voyage of from 55 to 75 leagues to and from the anchorages of Cromarty Frith to the north, and Leith roads to the south.

The area of this harbour originally extended only to about 6 acres, with a depth at high water so limited as not to exceed 12 feet at the entrance. In this state it was found wholly inadequate to the increasing trade of the district; and about the year 1806 an extension was projected and partly executed upon a design of the late eminent Mr. Rennie's. Since that period a new harbour has been formed northward of that above alluded to; connected with which quays have been constructed of the aggregate length of about 600 yards, which at their seaward extremity command at no time less than 9 feet, and rising from 15 to 20 feet at high water of neap and spring tides. The north harbour of Peterhead is therefore now capable of floating the largest merchant vessels and the smaller classes of His Majesty's ships of war.

Owing, however, to the want of a covering pier, the benefit of what has already been done is in a great measure lost to the public, as vessels at their moorings are exposed in stormy weather to the heavy surge of the north-eastern seas. To remove the disturbance complained of in the interior, and to connect the two harbours with their opposite entrances, is the main object of the improvements now projected and referred to in the accompanying plan.

To effect this it is proposed to carry a sea-wall or breakwater from Port Hendry on the opposite side to within 30 yards of the present north pier, and thereby include an area of upwards of 17 acres. A communication is also to be formed between the north and south harbours by opening a cut or canal of 40 feet in width for the transport of ships across the narrow neck of land which at present separates them. By these opposite entrances, vessels may enter or leave Peterhead in all directions of the wind. To preserve the thoroughfare, a drawbridge will be constructed across the canal; and to check any run of water that may be apprehended between the harbours, a set of beams, forming a simple kind of boom-gate removable by means of a crane, will be placed in it. In various parts of the harbour it will further be necessary to clear the rocky bottom and apply the excavated matters to the purposes of the new work.

Still to the northward of the improvements now suggested the extension of piers may be conceived from the opposite sides of the approach to the harbour, which would include a much larger area and command a depth of water extending to 4 or 5 fathoms, as shown in dotted lines upon the plan. Similar improvements are also applicable to the south harbour and its connecting bay; but works of such magnitude necessarily imply the expenditure of a much greater sum than the fund at present in view. It may, however, be noticed that the plan now proposed to be executed does not interfere with any further extension of the harbour, though in all probability this will not be required for a long period.

From the annexed estimates it appears that the enlargement of the north harbour, the formation of the cut of communication, and deepening the bottom, will amount to the sum of 31,510*l.* 17*s.* 0½*d.*

If it shall be found necessary to adopt a more modified plan than that of including Port Hendry, this may be effected by continuing the new quay by two *kants* in an oblique direction to within 30 yards of the north pier, as shown in dotted lines upon the plan. This modification would however only

No. 212.
Stevenson, on improving the Harbour.

include an area of 11 instead of 17 acres. But it is a maxim not to be lost sight of, that in harbours so exposed as that of Peterhead, it is essential to anything like a quiescent state that the width of the entrance should bear but a small proportion to the area included by the piers or walls of circumvallation; the greater area should therefore be preserved. By this modified plan it would also be attended with some difficulty to preserve a passage for the fishing-boats and small craft which frequent Port Hendry. The expense of this plan, including only 11 acres, would agreeably to the annexed estimate cost 26,171*l.* 7*s.* 7*d.*, being 5339*l.* 9*s.* 5½*d.* less than the expense of the pier extending from Seagate-street.

The formation of a wharf and road along the northern side of the ship-building yards, as shown in the plan, may be considered of as a subsidiary work for the accommodation of the harbour. Here also warehouses might be erected with great advantage. In order to put such minor works within the power of the trustees, the reporter has numbered the parliamentary plan, that notice may be given to owners and occupiers, in terms of the standing orders of the House of Commons, if such additional work shall be approved of. The road leading from the south harbour to Seagate-street and the new quay are by much too narrow. This observation is also applicable to the present access from the south harbour to the north pier. By the proposed notices it is provided that the trustees shall have power of widening and improving these approaches to the harbour; but no allowance has been made in the estimates for such works, or for the value of property required for their execution.

Were a wet-dock to be formed at Peterhead, in no situation could this be effected in a more simple and economical manner than by occupying that part of Port Hendry which is bounded by Seagate-street and the new quay. With this view the rocky bottom of that part of the harbour should as much as possible be quarried for the purposes of the work.

From the excellent granite quarries situated at no great distance from the works, masonry of the most substantial description may be executed at a comparatively small expense. The pier projected from Port Hendry is estimated of squared masonry with a parapet wall. A great part of this work, however, might be executed at a less expense in the form of a rough breakwater. To cover incidents and to meet contingencies, an allowance of from 10 to 25 per cent. has been made on the estimates. With regard to the time for completing the estimated works without inconvenience to shipping, the reporter is of opinion that four years would be required.

ROBERT STEVENSON.

To the Trustees for the Harbour of Peterhead.

Abstract Estimate of the Expense of improving Peterhead Harbour, agreeably to a plan and specification by ROBERT STEVENSON, *Civil Engineer, 7th November,* 1826.

First compartment of New Pier, extending 200 yards from Seagate-street.

	£.	*s.*	*d.*			
5,098 cubic yards of excavation in rock connected with Port Hendry, and in preparing the foundation of the outward walls, applied to the works of pier, at 3*s.*	764	14	0			
2,148 cubic yards of squared masonry, in the face-walls of pier, at 33*s.*	3,544	4	0			
7,742 cubic yards of rubble hearting between the outward walls, partly laid by hand, and partly of mound stones taken from the works of excavation, at 5*s.*	1,935	10	0			
589 cubic yards of squared masonry in parapet wall, at 36*s.*	1,060	4	0			
2,861 cubic feet of coping for top of inside wall of pier, at 1*l.* 10*s.*	262	5	2			
1,574 superficial yards of pitching or paving, at 7*s.* 6*d.*	590	5	0			
Mooring pawls and rings	42	0	0			
Incidents, calculated at 10 per cent	819	18	2½			
				9,019	0	4½

Second compartment, extending to within 30 yards of North Pier.

	£.	*s.*	*d.*			
12,012 cubic yards of excavation in rock connected with North Harbour, and in preparing foundations of outward walls of pier, at 3*s.*	1,801	16	0			
2,213 cubic yards of squared masonry in face-walls of pier, at 35*s.*	3,872	15	0			
1,482 cubic yards of rubble masonry in the backing of outward walls, at 27*s.*	2,000	14	0			
6,383 cubic yards of rubble hearting between the outward walls, at 7*s.* 6*d.*	2,393	12	6			
1,753 cubic feet of coping on inside wall, at 2*s.*	175	6	0			
752 cubic yards of squared masonry in parapet wall, at 40*s.*	1,504	0	0			
889 superficial yards of pitching, at 9*s.* 6*d.*	422	5	6			
Mooring pawls and rings	21	0	0			
Incidents, calculated at 25 per cent.	3,047	17	3			
				15,239	6	3
Total of New Pier				£ 24,258	6	7½

Third compartment, being the cut or canal of communication between the two harbours.

	£.	*s.*	*d.*			
9,666 cubic yards of excavation, chiefly in rock, in forming the communication between the two harbours, to be applied to the building, at 4*s.*	1,933	4	0			
7,550 cubic yards of excavation, partly in rock, in forming a low-water track on either side of the canal of communication, at 10*s.*	3,775	0	0			
Drawbridge across the canal	635	0	0			
Boom-gate and crane for canal	250	0	0			
Incidents, at 10 per cent.	659	6	5			
				7,252	10	5
Total of extended plan				£ 31,510	17	0½

No. 212.
Stevenson, on improving the Harbour.

Abstract Estimate of extending the present New Quay by two kants to within 30 feet of the North Pier, exclusively of Port Hendry.

Compartment from new quay to point of junction with the seaward kant, as shown in the plan.

	£	s.	d.
Works of excavation in preparing for foundation of outward walls	31	10	6
1,100 cubic yards of squared masonry in face-walls, at 30*s.*	1,650	0	0
5,066 cubic yards of rubble hearting between the outward walls, laid partly by hand and partly of mound stones taken from the works of excavation, at 5*s.*	1,216	10	0
1,207 cubic feet of coping on the inside walls, at 1*s.* 10*d.*	110	12	10
863 superficial yards of pitching, at 7*s.* 6*d.*	323	12	6
Mooring pawls and rings	12	15	0
Incidents, at 10 per cent.	334	10	1
	3,679	10	11
Amount of compartment second, as in the foregoing statement	15,239	6	3
Amount of canal communication, being the third compartment of the foregoing estimate	7,252	10	5
Total of modified plan	26,171	7	7
Ditto of extended plan	31,510	17	0½
Difference	£ 5,339	9	5½

No. 213.

Memorial in regard to the Harbours of Peterhead, in the county of Aberdeen, North Britain; their proposed improvement and extension; and their fitness for being formed into Harbours of Refuge.

No. 213.
Memorial on proposed improvement and extension of the Harbours.

March, 1844.

The east coast of Scotland is very much exposed to the heavy seas and storms of the German Ocean. It is much frequented by vessels of every description, shipping from various ports in Europe, America, the East and West Indies, and other parts of the world, on their passages south and north.

Between the Moray Frith and the Frith of Forth, a distance of nearly two hundred miles, there is no sea harbour where vessels can enter at all times of the tide. Embayed harbours having bars or river floods are not calculated to form Harbours of Refuge.

Looking to the numerous vessels which frequent the east coast of Scotland at all seasons, and keeping in view the extent of that coast, a Harbour of Refuge, having a sufficient depth of water at all times, would be of the greatest importance to the shipping interest of the country, not only in saving lives and property, but also in lessening expense to those engaged in the maritime trade.

The Harbours of Peterhead are situated in 57° 30′ north latitude, and 1° 32′ west longitude. The town of Peterhead stands upon the most easterly point of land in Scotland, and its Harbours are equally distant from the Moray Frith and the Frith of Forth. They were originally partly formed by nature, being protected by two small islands, and they have been divided by a road or causeway, running east and west, which forms a communication between them and the main land.

The South Bay of Peterhead extends about half a mile westward of the entrance to the South Harbour, and is bounded on the south by the promontory of Salthousehead. It affords excellent anchorage for vessels, which are there completely sheltered from all winds coming from points west of S.S.W. and N.N.E.

At a very early period the situation and usefulness of the Harbours of Peterhead, divided into north and south, attracted public attention. In the year 1705 an act of the Scottish Privy Council was obtained, authorizing a voluntary contribution within all the parish churches of the three Lothians and benorth the Forth, for building and repairing the Harbour of Peterhead; and in the year 1729 the Convention of Royal Burghs authorised a voluntary contribution through all the Royal Burghs in Scotland for the same purpose. Neither of these contributions, however, for reasons which it is unnecessary now to mention, took place; but in the year 1735 the Royal Burghs again authorised a voluntary contribution to be made for improving these Harbours, and which was made accordingly.

In 1773 the Convention of Royal Burghs, on considering a report from the Burghs of Aberdeen and Banff as to the great usefulness of the Harbours of Peterhead in a national point of view, voted a special grant of 500*l.* towards their improvement.

The South Harbour is protected by one of the small islands which have been mentioned, called Keith Inch, on the east, and by two piers built of granite, according to a design and plan of the late Mr. Smeaton, about the year 1770, on the south and west. Previous to the erection of these piers (the expense of which was defrayed partly by a grant from Government, and partly by contributions from the inhabitants), the improvements of the Harbours had been very inconsiderable, for the contributions received from the Royal Burghs had been required to keep the old bulwarks in repair, without affording the means of augmenting the dimensions of the Harbour. After the piers designed by Mr. Smeaton had been executed, the Harbour began to be enlarged by excavating the rock progressively from the inside of the piers, until in 1806 the Harbour became capable of containing from 50 to 60 sail of vessels of moderate draft of water.

In the year 1807 an Act of Parliament was passed, entitled "An Act for deepening, enlarging, maintaining, and improving the Harbour of Peterhead, in the county of Aberdeen." The preamble of that Act, which was proved to the satisfaction of the legislature, was as follows:— "Whereas the Harbour of Peterhead, in the county of Aberdeen, is of the utmost importance to navigation in general, being one of the safest and most accessible harbours on the east coast of Scotland, and much resorted to by shipping in the coasting trade, and might be greatly improved, and rendered still more beneficial to trade and navigation if the said harbour were deepened and enlarged so as to admit vessels of large burden, the North Bay or Harbour properly protected, and a passage or communication formed between the North and South Harbours."

This Act came into operation on the 1st of September 1807, and the Trustees named in it applied to

No. 213.
Memorial on proposed improvement and extension of the Harbours.

the Commissioners appointed by Parliament for applying certain balances arising from the forfeited estates in Scotland towards making canals, harbours, and other public works there, and obtained a grant from them of one moiety of 7800*l.*, being the amount of an estimate by the late John Rennie, Esq., civil engineer, for excavating 30,000 cubic yards of rock and other stuff from the bottom of the South Harbour. The other moiety was raised by voluntary contributions from the inhabitants of the town of Peterhead. The Trustees under the Act likewise became contractors for the above work, which was completed to the satisfaction of the Commissioners, as appears from their sixth report, wherein they state, in reference to Peterhead Harbour, "The improvement of Peterhead Harbour was completed at the date of our last report, and, upon final inspection at the close of the year 1811, it appeared that the contract and agreement between us and the Harbour Trustees had been fairly executed by them; and they have since transmitted to us a gratifying report of the benefit derived from the improvement thus effected. We have inserted their Report in the Appendix, and refer to it as better authority than any that can be produced.

In addition to the estimated sum of 7800*l.*, the Trustees under the Act expended 6000*l.* in building piers, and in forming an embankment, so as to make a communication with the Greenhill Island, and making excavations from the bottom of the Harbour.

The advantages derived from these improvements are detailed in the Report to the Commissioners already referred to, which forms the Appendix to this Memorial, No. 4.

Notwithstanding the increased accommodation procured in the South Harbour from the improvements before mentioned, and the additional depth of water thereby obtained, its extent was found still too limited to accommodate the shipping resorting to it belonging to the port, and those seeking its shelter from storms and contrary winds. It could not, however, be extended farther into the land, without purchasing private property at a high rate; and in these circumstances, the Trustees were induced to turn their attention to the North Harbour.

It had been the opinion of several able engineers that an extensive and commodious harbour could be built in the North Bay of Peterhead, protected on the south-east by the Greenhill Island, and that a cut or communication between the North and South Harbours would then render these harbours equal to any in Scotland.

Acting upon the plans and report by Mr. Rennie, the Trustees of the Harbour accordingly proposed to construct a pier or breakwater from the Greenhill, extending 400 or 500 feet into the bay—to form a dry-dock in the Greenhill—and to build a wharf, extending along the face of the embankment which had been then already formed between the South Harbour and the Greenhill. The advantages anticipated from these works were that the North Harbour would afford accommodation to a greater number of vessels than the South Harbour,—that it would have a depth of water, for a considerable space within the pier, sufficient at all times to admit merchant ships of considerable burden,—and that ultimately a cut or communication might be made between the two Harbours, so as to unite them, and so that vessels seeking shelter might have the singular advantage of entering the Harbours or sailing from them with the wind at any point of the compass.

Under these circumstances, the Trustees again applied to the Commissioners for disposing of the balances of the Forfeited Estates Fund, offering to advance 10,000*l.* towards the above purposes, if the Commissioners, on the part of the public, would advance an equal sum. The Commissioners granted the request of the Trustees, and sent the late Mr. Thomas Telford, civil engineer, to investigate in regard to the proposed harbours, and to prepare plans and estimates for having the proposed improvements executed. After Mr. Telford had given in plans, with estimates and specifications, the Harbour Trustees again became contractors, and the work made rapid progress until the 23rd and 24th days of October 1819, when a violent storm happening, overthrew and did great damage to the unfinished pier. The loss was estimated at 3400*l.*; but the Trustees again applied to the Commissioners, and obtained a sum towards repairing the damage.

The North Harbour was shortly afterwards completed, in terms of the contract, and the following report in regard to it is contained in the Ninth Report of the Commissioners:—"*Peterhead Harbour.*—The flourishing town of Peterhead is situated on the coast of Aberdeenshire, and occupies a more easterly position than any other place in Scotland. A rocky island now joined to the shore, called the Greenhill, forms a North and South Harbour. The latter has hitherto been in use, and towards deepening this, and extending the western pier, we granted a moiety of 7800*l.*, the Harbour Trustees raising the other moiety, and also 2076*l.*, which, with the above sum, had been carefully expended on the South Harbour in the year 1811.

"The ground on which the town stands belongs in property to the Merchant Maiden Hospital of Edinburgh, and the Trustees then began to turn their attention to the Northern Harbour, by improvement of which they hoped not only to obtain deeper water, and to double their sheltered space, but also to ensure an easy entrance into one of the two harbours, from whatever quarter the wind might blow; with this intention they raised 10,000*l.*, and applied to us for aid, and to the like amount, which we were enabled to grant in the year 1818.

"The protecting pier extends 470 feet in a line directly northward from the high-water mark of the Greenhill before mentioned, half that distance into the sea from the low-water mark, the inside wall being founded on caissons, and the curved end of the pier extends towards the west 80 feet, founded also on caissons, 10 feet under low-water mark, which, with the usual rise of tide, is sufficient for the entrance of the largest vessels employed in the Greenland fishery.

"The solidity and construction of this pier were such as the exposure of the situation seemed to require; but the violent storm which happened on the 23rd and 24th of October 1819 overthrew so much of the unfinished masonry that the damage was estimated at 3400*l.*, one-half of which the Trustees offered to contribute, but were unable to take the whole upon themselves. In this emergency they again applied to us, and subsequently to Parliament, without success, and thus, all other means failing, we were at last constrained to appropriate to the restoration of the Peterhead Pier, and that of Banff (which had suffered in the like manner), certain sums already assigned to other improvements, but not definitively accepted by contribution of equal sums.

"The basis of the new Pier at Peterhead has been widened by the mode of reparation adopted, and its power of resistance proportionally increased. It is nearly finished, as is also the deepening of the North Harbour and the wharf wall at the root of the pier. A spacious graving-dock is included in the same contract, as a concomitant improvement for the completion of the new Harbour."

On the 14th day of October 1822, the Trustees were paid the balance due to them by the Commissioners, the contract having been previously fulfilled on their part.

APPENDIX C.

PETERHEAD.

No. 213.

Memorial on proposed improvement and extension of the Harbours.

The improvements made on the Harbours up to this period were not only of great local, but of great public utility; and no better evidence perhaps can be exhibited of this than by comparing the number of windbound vessels which took shelter in the Harbour of Peterhead with those which took shelter in the Harbour of Ramsgate (on which latter so much of the public money has been expended) during the seven years which followed the improvement of each respectively. A statement showing this will be found in the Appendix, from which it appears, that, while the number of wind-bound vessels which took shelter in Ramsgate was only 984, the number which resorted to Peterhead, exclusive of boats, was 1954.

Since 1822 many additions and important improvements have been made upon both harbours, and a large quantity of rock and other stuff has been removed. The most important addition is a pier on the north-west boundary of the north harbour, which cost upwards of 6000*l.*

The first Act of Parliament for improving the harbours of Peterhead was obtained in 1807, to continue for 21 years only, and therefore it became necessary subsequently to apply for a new Act. This was accordingly done in 1827, when an Act was obtained with additional powers to the Trustees, and unlimited in duration.

The area of the south harbour is 6·6 imperial acres. The area of the north harbour is 10·86 imperial acres. The length of the south quay of the south harbour is 480 feet; its greatest breadth is 42 feet; the height from the base to the top of the parapet 40 feet. The extreme length of the west quay is 653 feet; the length of the parapet 352½ feet; the height of the parapet 26 feet; and the greatest breadth at entrance 90 feet. The total length of the quays at the north harbour is 2219 feet, and the area of these quays 4 acres, 3 roods, and 28 poles.

The number of vessels belonging to the port of Peterhead at present is 72, and their tonnage 12,701.

As regards the shipping belonging to the port of Peterhead, the accommodation in the present harbours is sufficiently extensive, although, were the improvements after mentioned to take place, the ship-owners of Peterhead would participate in them along with the shipping interest in general. But Peterhead has now become of national importance as regards the herring fishery,—the quantity caught annually averaging from 50,000 to 65,000 barrels; and it being recognised as the best herring-fishing station on the east coast of Scotland, the accommodation for this branch of trade is fully occupied, and, were there more accommodation, there can be no doubt that it would be occupied.

The great importance however of the harbours of Peterhead, in a national point of view, is the shelter and accommodation which they afford to vessels requiring protection from storms or adverse winds. The importance which these harbours have attained in this particular, it will be seen, has been recognised and acknowledged for upwards of 120 years, and as a proof of it at the present time, it may be mentioned that on an average of the last ten years, vessels to the number of 237 have annually found shelter and protection in the harbours of Peterhead. The numbers in each year are stated in the Appendix, No. 7.

The situation of Peterhead, too, renders it a very convenient place of call for vessels from foreign ports bound to the east coast, as well as for vessels from ports in the Baltic, and the northern ports in Europe generally, whether bound to the east or west coasts; and at all seasons of the year many vessels put in there for that purpose. Vessels from the Baltic, likewise, and the coast of England, when bound to the northward, or when driven thence during storms, generally make the land of Buchanness, which is distant about two miles from Peterhead, and situated on the south side of the South Bay, and on which a lighthouse, which has proved of the greatest importance to the navigation of the coast, has been erected since 1827. To vessels in either of these circumstances, when overtaken by storms or contrary winds, were the harbours of Peterhead of sufficient depth of water to admit for shelter the larger class of merchant ships, as these vessels generally are, their importance would be very greatly enhanced. While affording shelter and safety to such vessels, they would save them the risk of being driven off the land in westerly gales, and enable them to take advantage of the first favourable wind to make their ports of destination.

The harbours of Peterhead, especially the south harbour and the inner north harbour, have been formed out of the granite rock which protects them on all sides. This rock in the bottom of the harbours is in a gradual state of decomposition, but this, notwithstanding, it is perhaps as difficult to remove as if it were fresh rock, while it is of no value as stone after being removed. The south harbour and the southmost half of the north harbour are tide harbours, and are dry at spring tides. The general rise of the tide at springs is 11 feet 6 inches, and at neaps 5 feet 6 inches.

The average depth of water at springs is, in the south harbour 11 feet 6 inches; in the southmost half of the north harbour 11 feet; and the northmost half of it 15 feet 6 inches; and at neap tides the average depth of water in the south harbour is 8 feet 6 inches; in the southmost half of the north harbour 8 feet; and the northmost half of it 12 feet 6 inches.

Upon referring to the plan it will be seen that the mouths of the harbours lie in opposite directions, the one opening to the south and the other to the north, and that they are separated from each other by a mound called the Sand Bridge. The sea formerly at high water passed between the harbours, and this mound was formed to effect a permanent communication between the town and the islands of Keith Inch and Greenhill. The advantages of a cut, canal, or communication between these harbours have been contemplated, as has been seen, for more than a century, but still remain to be accomplished. It is true that at no distant period the Trustees of the harbours might from the ordinary revenue be able to make this cut or canal to the depth of the present harbours at their highest level where they meet the said bridge. This however would effect but a very partial improvement, as only vessels of small draft of water would be able to pass from the one harbour to the other, while vessels of large draft of water would be in no better situation than they are at present. The harbours of Peterhead are of so much public and national importance that the Trustees would not feel themselves justified in uniting them, unless in such a way as to make them most extensively useful, nor would they do this without first bringing the matter fairly before the shipping interest of the country, and obtaining the sentiments of those interested in this important subject.

What is required is an additional depth of water over the whole of the south harbour, and a considerable part of the north harbour, so that vessels of the largest burthen might never be neaped. Four feet of additional depth in the general case would effect this most important object; but as a national object, perhaps not less than 6 feet of additional depth might be more advisable.

At present detention of the numerous vessels which find shelter and are windbound in the harbours of Peterhead arises from two causes, the vessels either being neaped or detained by contrary winds

No. 213.[1]
Memorial on proposed improvement and extension of the Harbours.

were the harbours deepened, and a cut or canal made between them, neither of these causes would exist, and no vessel would be detained a single day beyond what might be required from the state of the weather, and thus a very great saving would be effected to the shipping interest frequenting the east coast of Scotland, and requiring to enter the harbours of Peterhead. But this is not all, for it appears to be a fact that many vessels rather run the risk of remaining at sea than being detained in the harbours of Peterhead by being neaped, or by contrary winds, and that at the risk of the lives of the crew, and damage to the vessels themselves.

If harbours of refuge tend to promote the interests of the shipowners, to save the lives of the crews, and to preserve the property of the merchants, no place between the friths of Moray and Forth seems to possess so many advantages for that purpose, or to have been so long looked to and recognised by parties competent to judge, as Peterhead, standing as it does on the eastmost point of Scotland, projecting into the sea—its harbours protected by the two islands before mentioned, and having been known as harbours of refuge for ages past.

The excavating of rock below the low water of ordinary tides would no doubt be attended with very considerable expense. It might be done either by cofferdams, or by excluding the sea altogether, and forming the harbours into cofferdams; and if this latter mode were preferred, one of the harbours could be kept open during the time the works in the other were under execution. But the proper plans to be followed would depend upon the report of an engineer of abilities and experience, who would be able to estimate the probable expense.

The Trustees of the Harbours under the Act of Parliament 1827 are bound to apply the rates and duties in payment of the interest of the money borrowed in virtue of the powers contained in the Act, in defraying the necessary expenses of management, keeping the present works in repair, in gradual liquidation of the debt, and in executing such additional works as the state of the funds may admit. No part of the revenue can be applied to any other purposes.

Were government to approve of rendering the harbours of Peterhead harbours of refuge, and to grant the necessary means for doing so, it appears probable that a moderate rate of interest might be paid on the sum to be advanced from the additional rates and duties which might be collected in consequence of the additional accommodation, after providing for the interest of the present debts, the gradual liquidation thereof, and other necessary expenses under the Act of Parliament. In that case, too, the harbours might be both extended and further protected; but the deepening and connecting them by a canal, while it appears to be the first and greatest object, would be likewise a matter of national importance.

The present Memorial has been drawn up under the authority of the Parliamentary Trustees of the Harbour, with the view, in the first instance, of giving information to the shipping interest, and, if the improvements contemplated meet the approbation of shipowners generally, with the ulterior view of making application to Parliament for the necessary means to carry these improvements into effect, and thereby to make the harbours of Peterhead more available as harbours of refuge on the east coast of Scotland.

No. 214.

Report of DAVID STEVENSON, ESQ., F.R.S.E. & M.INST. C.E., *Engineer to the Convention of Royal Burghs of Scotland, on the Harbour of Peterhead.*

Edinburgh, January 25, 1847.

No. 214.
Stevenson, on improving the Harbour.

GENTLEMEN,

IN the months of September and October last I made two careful inspections of Peterhead Harbour, and attended meetings of the trustees, from whom instructions were received to make a survey of the harbour, and to procure such information as was necessary to enable me to form a design and estimate for its improvement. While on the spot, opportunity was taken to obtain the evidence of several seafaring persons possessing intimate knowledge and long experience of the port, both as regards the nature of the trade and the state of the harbour; and having since that time procured minute plans and sections, and carefully considered the subject in all its bearings, I have now to submit the following Report:—

The memorial drawn by Provost Gray in 1844 contains so full and clear a digest of the past history and present condition of the Harbour of Peterhead, that it appears unnecessary to devote any part of this Report to the discussion of that interesting branch of the inquiry, and I would rather refer to that document for all such information. I shall, therefore, in the introductory observations, confine my attention to a few general views respecting the establishment of a Harbour of Refuge on the east coast of Scotland, and to some circumstances specially relating to Peterhead, which have been more immediately suggested by the late inquiry which was instituted at that place, and by the survey of its harbour, which has just been completed.

That portion of the eastern coast of Scotland which stretches from the Firth of Forth to the Firths of Inverness and Cromarty is about 250 miles in length, and throughout its whole extent there is no place of safety to which vessels can at all times run when overtaken by easterly gales. Hence it has happened that vessels, after being abreast of Aberdeen and other ports of that district to which they were bound, have occasionally been forced to run for shelter to the Firth of Forth on the south, or the Firth of Cromarty on the north, being driven from 100 to 150 miles out of their course. The class and number of shipping which are subjected to such detentions and dangers are by no means unimportant in a commercial point of view; for, besides including within its limits Dundee, Arbroath, Montrose, Aberdeen, Peterhead, Banff, and many smaller ports, the line of coast referred to is more or less frequented by the whole of the shipping engaged in the Greenland whale fishing and the northern trade of Scotland, including that of the Orkney and Zetland Islands, and is also navigated by all vessels from the south which approach or leave the German Ocean by the northern passage of the Pentland Firth or the Caledonian Canal. It is therefore obviously a much frequented coast, and in proof of this, it is only necessary to refer to the returns of the collector of the dues for Girdleness Lighthouse at Aberdeen, from which it appears that during the year 1845 the vessels passing that station amounted to no fewer than 11,453 sail, exclusive altogether of those which were in ballast, or of boats under fifteen tons burden, of which, as being exempt from light dues, no account is kept. That this large fleet of shipping engaged in navigating a generally rocky and dangerous line of coast of 250 miles in extent should have been so long unprovided with the means of shelter at some inter-

APPENDIX C.

PETERHEAD.

No. 214.
Stevenson, on improving the Harbour.

mediate point between the Firths of Forth and Cromarty (the only accessible anchorages in all states of the weather), can only be accounted for from the fact that its configuration, generally speaking, affords few facilities for the establishment of an asylum harbour without incurring a considerable outlay. The natural inlets of the Tay, the Esk, and the Dee are obstructed by sandbanks and bars, while the other bays which occur are not deeply indented, and afford but a small amount of sheltered water. But although these are the general features of the coast, there are nevertheless particular parts of it to which the attention is at once directed as presenting certain facilities for the establishment of harbours; and after minute inspection, and long-continued investigation, I am of opinion that there is no point in the whole district alluded to which possesses so many physical advantages for the formation and maintenance of a harbour, either on a modified or a large scale, as the Promontory and Bay of Peterhead.

The favourable characteristics of Peterhead consist *generally* in its advantageous position on the coast, and *locally* in the natural facilities presented by it for the formation and maintenance of a harbour of refuge.

Its general qualifications consist in its being situated, as the trustees are aware, on the most eastern promontory of Scotland, and therefore forming the turning point of the coast; while it is further to be observed that it is not far from being midway between the Firths of Forth and Cromarty; from which circumstances it may be fairly argued that an accessible harbour at that point would prove very generally serviceable to shipping, and, on the whole, perhaps, would be more usefully situated than if placed nearer to either of the important roadsteads above mentioned.

But whatever general recommendations Peterhead may possess, these are unquestionably of small importance compared to its very valuable local facilities; more especially when it is kept in view that the want of funds for constructing a harbour on an iron-bound and otherwise disadvantageous shore is the great obstacle which has hitherto obstructed the establishment of a refuge harbour for the east coast of Scotland, and that it is therefore of primary importance to adopt, as the site of any extended works for such a purpose, the situation which, from its superior natural facilities, is best calculated to afford the desired accommodation at the smallest expense.

These local advantages I shall proceed briefly to point out, and for this purpose it will be necessary to refer to the accompanying Plan No. I, on a small scale, which is taken from the Admiralty Survey. From this it will be observed that the coast at Peterhead assumes the form of a promontory, having to the north an exposure open to all winds from east to north, and to the south an indentation of about a mile in depth, forming what is called Peterhead Bay, well marked on the south by the sea-light of Buchanness. This bay is open to winds from east to south, but is nevertheless generally acknowledged to be the most useful anchorage on this line of coast, and is indeed the only achorage shown on the Admiralty Survey. At the extremity of this promontory, and separated from it by a narrow sound, there was originally an insulated rock, called Keith Island, which, however, is now connected with the mainland by means of an artificial mound or embankment. This island, which now forms a natural breakwater for the North and South Harbours, may be described as about half a mile in length and quarter of a mile in breadth. The *alveus* or bottom between it and the shore is composed of rock, and its configuration is such that both its north and south extremities form, with the adjoining shore, indentations or creeks which maintain a good depth of water for some distance landwards. These indentations or small bays are the present North and South Harbours of Peterhead. But this island not only shelters the interior of the present harbours (which aggregately are about seventeen acres in area), but, as will be readily seen by examining the plan referred to, its extremities form a protection, to a great extent, for the north and south entrances—for whatever be the direction of the wind, the waves are invariably more or less broken by the outlying rocks. From this explanation, then, it will be understood that the present harbours of Peterhead are natural creeks or sheets of water between Keith Island and the mainland; the interior being in a great measure sheltered without the aid of artificial works by the island itself, and their entrances formed by piers which are also to a great extent under the lee of its projecting extremities.

Another advantage attending the locality of Peterhead consists in the *formation* of the adjoining coast, which is almost entirely granite rock, the beach being quite free from sand. This circumstance, (which is probably in a great measure due also to the prominent position of Peterhead beyond the general line of coast,) when viewed in connexion with the deep water already existing around Keith Island, renders the situation peculiarly fitted for the establishment of a harbour upon a large scale; and although sand does occur in the bay considerably seaward, it is so far removed as to leave no ground for apprehending that any alteration of the currents consequent on the construction of new works will cause accumulations of sand, which, it is well known, have occurred to a greater or less extent in many of the harbours on the east coast of Scotland; and in some instances, where extensive marine works have been executed in the vicinity of such dangers, the depositation has increased to such a degree as in a short time greatly to destroy their utility. I shall only notice further, in adverting to the natural facilities of the situation, the immediate proximity of the Bay of Peterhead, which, as already mentioned, is the best anchorage on this coast, and also the abundance of durable materials for marine works afforded by the well-known granite quarries of that district, which are in the immediate vicinity of the town, and from which the existing piers and quays have been entirely built.

From this brief sketch it will, I think, be apparent that the natural advantages of this locality are of no ordinary kind, and may well justify the opinion which I have formed, that it is the best situation for the establishment of a harbour of refuge on the eastern shores of Scotland. All, indeed, who are acquainted with the coast will, I think, readily admit that there is no other place which presents the same extent and combination of advantages such as have been described, consisting of natural shelter, well marked by day and by *night*—good anchorage ground—deep water—absence of sand—and abundance of durable building materials, which are elements of the highest importance in the successful formation and future maintenance of a harbour.

The gradual advancement of the port is fully described in the memorial already alluded to, the works having been at various periods designed, executed, and reported on by Messrs. John Smeaton, John Rennie, Thomas Telford, and Robert Stevenson. They now consist, as has been already noticed, of the North and South Harbours, the former being 11 and the latter 6 acres in area. The depth at the entrance to the North Harbour is 9 feet, and that at the South 3 feet at low water of ordinary spring tides rising 11 feet 6 inches. Their relative positions will be best seen by referring to the accompanying enlarged plan, No. II., which has been made from a survey lately taken under my direction, and represents more minutely than former plans the low-water outlines, and also the soundings in

No. 214.

Stevenson, on improving the Harbour.

the harbours and adjoining bays, towards the accurate delineation of which this survey was particularly directed.

Before proceeding to state my views as to the proposed improvements, and the manner in which these will be best effected, it may be proper to refer shortly to the notes of evidence kindly afforded at my last visit to Peterhead, a copy of which is appended to this Report. That evidence was given in separate examinations of the parties, and is valuable as coming from persons of practical experience and long acquaintance with the port. It is also highly satisfactory on account of the remarkable uniformity of opinion which pervades the whole of the evidence, and although some of the persons examined, hold views peculiar to themselves, still it will be found that even these views are not inconsistent with the main points of the question, on which all are agreed, but are exactly what might have been looked for when various intelligent persons review a subject embracing a diversity of points, which of course present themselves to different minds in different degrees of importance. Without going minutely into the evidence, it is perhaps only necessary to observe generally, that the following facts and opinions seem to be admitted by all parties.

The bay of Peterhead is acknowledged to be the best anchorage on this dangerous coast. The entrance to the *South* Harbour is, on the whole, stated to be good, even in its present state, but admits of improvement, by the removal of the Maw Rock. No day occurred last year in which a vessel could not take the South Harbour on account of sea or wind, and it is asserted that if a vessel can live in the sea, she can, at proper time of tide, and under proper management, take the South Harbour. Vessels have occasionally been injured or wrecked in taking the harbour, but such accidents chiefly occurred previous to the removal of certain rocks which incommoded the entrance, and no vessel ever received injury at her berth in this harbour, which is said to be very still. The winds which cause the greatest run at the entrance of the South Harbour make comparatively smooth water at the North; and, in like manner, the winds which cause most sea at the entrance of the North, give smooth water at the South. The South Harbour has not been cleared for four years, and the deposit, which is very trifling, is supposed to be in a great measure produced by the sewers of the town, which discharge themselves into it.

The *North* Harbour, on the other hand, is more exposed, and but for its greater depth of water is by no means so good, being neither so sheltered nor so easy of access as the South. The outer or deep water part of the basin is at times unsafe, but the inner part is perfectly secure, although *even it* is said to be more exposed to the run of the sea than any part of the *South* Harbour. The improvements which these parties have suggested, and the order as regards importance in which they appear to be generally regarded, are—the removal of the Maw Craig, the deepening of the present harbours, and the formation of a short cut or canal between the two harbours, so as to make either entrance available for ingress and egress according to the state of the wind; and farther, while a few persons advocated a slight extension of the South Pier, and also an additional covering pier for the North Harbour, all were agreed that if works on an extended scale were undertaken, these should be formed in the Bay of Peterhead, and in connexion with the South Harbour.

This general statement of evidence acquiesced in by all who were examined on the subject, agrees completely with my own preconceived ideas, formed after a minute examination of the place, (and stated in evidence before the Tidal Harbours Commissioners on their visit to Peterhead in September last), and I have consequently had increased confidence in laying out the works for the improvement of the harbour, which I have now the pleasure of submitting for the consideration of the trustees.

These works are represented in the accompanying Plan, No. II, and have been devised so that they may either be taken progressively or simultaneously, and may be executed as a whole design or in part only, as may best suit the views and resources of the trust.

The most important operation, and that which calls first for the exertions of the trustees, is undoubtedly the excavation of the interior of the harbour, and the removal of obstructions from the entrance, and in connexion with this, the formation of a cut or canal for joining the two harbours. It is proposed to excavate 4 feet, so as to secure a depth of 15 feet at high water of ordinary springs; but I have also taken into consideration the practicability of carrying the excavation to 6 feet, which would further afford accommodation, not to local or coasting vessels alone, but to the general trade of the country. I have also designed, on a large and a modified scale, an outer low-water harbour in Peterhead Bay, as shown in the plans, which would at once satisfy the largest wants of the trade, and afford shelter and accommodation for vessels of every class. The junction of the two harbours would farther greatly increase the convenience of the port, as vessels making or leaving it could choose the north or south opening, according to the state of the wind and sea, and would also have an opportunity of taking up their berth in either of the harbours which might be most convenient for them, with a perfect confidence that they would not be detained by contrary winds, as the choice of a north or south *loose* from port would be always in their option.

From the data received at my visit, and from other sources, I have formed a probable estimate of the cost of the several works alluded to, which is appended to this Report. By referring to this it will be seen that the estimate for excavating the harbours to the depth of four feet, removing the Maw Craig, and forming the connecting canal, is 25,584*l.* sterling, while the cost of carrying these works to the depth of six feet, instead of four feet, is 32,432*l.* sterling. The estimate of the proposed refuge harbour in Peterhead Bay, as shown in red on plan No. II, but which may, if necessary, be greatly modified, is 227,905*l.* The extended plan, shown in dotted lines, is estimated at 450,912*l.*

In conclusion, it is only necessary to offer a very few general remarks in explanation of the method of executing these works; and on this subject it may be stated that the estimates are formed on the supposition that a diving-bell is to be employed for excavating any rock that may require to be removed at the entrance to the harbour, and that the interior is intended to be laid dry by means of coffer-dams formed along the inside of the present piers, so as to allow the works to go on speedily and without interruption. As the outer part of the North Harbour is much exposed, it has been considered best to restrict the excavation at that place, to the inner portion only of the harbour, from which a track is proposed to be cleared to deep water, which extends considerably within the pier-heads. I have also assumed that the excavated materials are to be conveyed by tram-road or railway, for the purpose of making up ground for herring-curing, in continuation of that already formed at Keith Island; and what is not required may be removed to the waste land to the north of the Roanheads, where it can be deposited beyond the reach of the tide. The cut or canal will be excavated in the same manner, the communication for traffic preserved by means of a swing or drawbridge, while the water and gas will be conveyed across it in pipes, passing along the bottom. With reference to

APPENDIX C.

PETERHEAD.

No 214.
Stevenson, on improving the Harbour.

the fears suggested by some parties lest the opening of the cut should cause too great a run through the harbour, I am of opinion, from a careful investigation of the simultaneous tidal observations made at the North and South Harbours during October and November last, that no practical inconvenience can possibly arise from this cause. The piers for forming the proposed refuge harbour in the bay are assumed as being built of rough blocks, and their extremities or pier-heads as being constructed of cut stone, and set with the diving bell. The extent of this part of the work may, as before stated, be greatly modified, and the expense proportionally decreased. The details of these different operations it is unnecessary at present to enter upon, and I have only to state further my decided confidence in the practicability of every part of the works laid out, and my belief that were they executed in the manner proposed, an almost inestimable benefit would be bestowed on the shipping which navigate the eastern coasts of Britain.

DAVID STEVENSON.

To the Parliamentary Trustees of Peterhead Harbour.

ESTIMATES FOR THE IMPROVEMENT OF PETERHEAD HARBOUR.

No. I.—*Deepening North and South Harbour Four Feet, and forming a communication between the Two Harbours.*

Expense of excavating interior of harbours and communication between them—mason work connected with communication—swing bridge—taking across water and gas, including coffer-dams, steam-engine, pumping apparatus, and 10 per cent. for incidents . . £25,584 0 0

No. II.—*Deepening North and South Harbours Six Feet.*

Expense of excavating, and other items as above mentioned . . £32,432 0 0

No. III.—*Estimate of Harbour of Refuge on a large scale, as shown in dotted lines in Plan No. II.*

Expense of forming an eastern pier 2085 feet long, and a western breakwater 1600 feet long, as shown in dotted lines, including 10 per cent. for incidents . . £450,912 0 0

No. IV.—*Estimate of Harbour of Refuge on a smaller scale, as shown in red colour in Plan No. II.*

Expense of forming an eastern pier 1373 feet long, and a western breakwater 570 feet long, including 10 per cent. for incidents £227,905 0 0

Notes of Evidence taken at Peterhead in October 1846, *by* DAVID STEVENSON, C.E.

ALEXANDER SOUTTAR has been harbour-master of Peterhead twelve years, and previous to that commanded a vessel nine years. The prevailing wind in winter is westerly, and in summer easterly. As the harbours stand at present, the south one is safest inside, and most easily entered.

South Harbour.—The heaviest sea is with wind S.S.E. to S.S.W. The straight course into the harbour mouth is E.N.E., with the wind from S.S.E. to S.S.W. (from whence the heaviest seas come.) The harbour can be easily taken. The worst wind for taking the harbour is N.E. to E., but always smooth water with wind in that direction. Is certain that there has not been a day for the last year that vessels could not take the South Harbour. In consequence of state of sea or wind, vessels have been injured in entering it, but not often. Never knew the slightest damage happen to a vessel lying at the quay inside of the harbour. The trading vessels frequenting the coast run from 120 to 130 tons, and draw from eight to twelve feet loaded. They have three regular traders to London, and two to Leith. They bring general cargoes for the supply of Peterhead and the neighbourhood, and take sometimes ballast and sometimes stone. They have a good deal of trade with Norway in the summer. From November to March a good many vessels take shelter.

North Harbour.—The heaviest sea is from N.N.E. to N.E. The most difficult wind for making the harbour W.S.W.; but wind from N.N.E. to N.E. (the worst for North Harbour) always gives smooth water at South Harbour. The outer North Harbour has a great run in N.N.E gales. Vessels have often been injured in it; but never knew of a vessel being wrecked in it. The new quay of North Harbour not safe in heavy gales; but the inner harbour south of the graving docks is quite safe. Vessels have come into North Harbour for shelter when they could not get into South Harbour from want of water. The heaviest seas are decidedly at the North Pier-heads. Does not think that the South Pier would stand at the North Harbour. The light at the South Pier is red—no light at North Harbour. The draft of the largest whalers is eighteen feet. The largest vessels that take shelter draw thirteen or fourteen feet.

Improvements.—The South Harbour is most in want of being deepened over its whole area. Considers four feet of additional depth would be a great benefit. The pier-heads are very good, and the entrance has never been complained of; but if the Maw Craig Rock were removed, it would improve the entrance.

The North Harbour is most in need of being deepened all over, the same depth as the other. Considers that the present entrances are perfectly good, if depth all over were obtained.

The connexion between the Harbour would be of great importance.

The South Harbour has not been cleaned for four years; and believes that it is chiefly from the town sewers, which run into it, that any accumulation takes place. Nothing comes into the North Harbour. The breadth of beam of the largest vessel is thirty feet. Has seen 120 vessels in South Harbour (area six acres). Fishing boats draw five feet when loaded.

Peterhead Bay is clay and sand; good holding ground; not much sand in head of bay. Has known vessels ride out a heavy gale from S.S.E. The bay affords shelter in winds from W.S.W. to N.E.; from six to eleven fathoms water. The distance from pier-heads to clear ground is 180 fathoms, and from south side of bay 230 fathoms. The new street open is the best anchorage. Vessels have touched the "South Head" Rock from not giving a wide enough berth.

Aberdeen Bay.—Vessels may ride in it with winds from S.W. to N.N.W. Bottom all sand; not a good bay.

JOHN SOUTTAR.—Has been trading from 40 to 50 years to and from Peterhead. S.E. wind causes

APPENDIX C.

PETERHEAD.

No. 214.
Stevenson, on improving the Harbour.

the greatest sea at South Harbour, and N.E. and N.N.E. at the North Harbour. Worst wind for taking South Harbour E.N,E.; worst for getting in S.W. *The South Harour* is good to take. If a ship can live in the sea she can take the harbour. Never knew a vessel injured with any wind when entering. Considers that it wants to be deepened three or four feet. Thinks that the cut would be of advantage, and that it should be forty feet wide.

Peterhead Bay is a good anchorage. Never saw a vessel drive in it. Depth six to twelve fathoms.

Aberdeen Bay is open, and has sand bottom.

Brough-head is a good place, but little water. Considers Peterhead the best harbour between the Firths of Forth and Cromarty.

WILLIAM MACKIE.—Has been sailing fourteen years out of Peterhead. It is a good entrance, the south one, but could be improved with extension of pier, and removal of Maw Craig Rock. Thinks the deepening the chief object in the first instance. Four feet additional would do for coasting, and six for general trade. The South Harbour is far the best entrance. The North Harbour has most sea, and is not so good an entrance. The outer harbour is not safe, but the upper harbour is perfectly safe; but there is more run even in the upper North Harbour than in any part of the South Harbour. The heaviest seas are from the N.E.

Aberdeen Bay is not equal to Peterhead. Never was in it in bad weather. Thinks Peterhead the best harbour on the coast. Coasting vessels about seventy to eighty tons.

Mr. SIMSON (one of trustees of harbour).—Considers that depth is most wanted. Vessels with S.E. winds sometimes go to the back of South Pier. Knows of no vessel that has done so this year. Proposes an extension of South Pier in present line. Worst winds east. Vessels sometimes go to back of pier in coming out. Vessels strike the Maw Craig in west winds from avoiding South Pier; and if the South Pier were extended, they would keep closer. Thinks that the Maw Craig should be removed, but would prefer the extension of the pier first. No damage was ever done in the South Harbour. The cut would be a great advantage. Thinks four feet of additional depth would be sufficient for local and coasting trade. Thinks the South Pier rather weak, and ought to be strengthened. Does not know what could be done to improve present entrance of North Harbour. From forty to sixty feet would be sufficient to lengthen the South Pier. Thinks fourteen feet at high water a sufficient depth.

Mr. VOLLUM, shipmaster (one of the trustees of harbour).—Has no objection to entrance or interior of South Harbour, but wants four feet more depth.

North Harbour.—Proposes an outer pier for North Harbour running from Port Hendry, but prefers the deepening and cut. For anything on an enlarged scale the South Bay must be looked to.

Captain GRAY (one of the trustees).—Has known Peterhead all his days.

South Harbour.—Even with its present depth he considers the South Harbour of Peterhead the best between the Firths of Forth and Cromarty. It is decidedly a safe harbour. For present trade, should be deepened; and for general purposes, the cut should be made. Whatever is done should be done in the South Harbour. Thinks three feet sufficient. The harbour is perfectly safe; never knew a vessel injured in it.

North Harbour.—Outer harbour not safe; inner harbour safe; entrance not good. Thinks the parapet of the North Pier is rather too low. Does not think that anything is required at the South Pier. The width of the cut should not be less than thirty-six feet. Thinks there will be a current of five knots per hour through it.

Peterhead anchorage is good.

Aberdeen bad; all sand. If anything in a great scale is done, it should be in the South Bay of Peterhead. Thinks the cut would not do without gates, owing to the current.

Mr. BURNETT (Ship Captain).—Entrance to South Harbour rather narrow, but should remain as it is. Thinks that the entrance would however be improved by extending the pier. Approves of South Bay for Harbour of Refuge. Thinks gates would be required to check flow of water through cut, and at pier heads.

Mr. JOHN YOUNG (one of the trustees).—Thinks the improvements should be taken up in the following order:—*1st*, Deepen (chief improvement). *2nd*, Bring out South Pier. *3rd*, Make cut. *4th*, Deepen upper part of North Harbour. The improvement of South Pier intended chiefly to facilitate entering and leaving the harbour; 60 feet of extension would be enough. Present harbour has a good entrance.

Captain ANDERSON (one of trustees).—Present entrance to South Harbour is good. Prefers deepening and making cut to interfering with present entrances. Anything to be done on a great scale should be done in the South Bay.

No. 215.

List of Wrecks in the Vicinity of Peterhead 1816–22.

Date.	Name.	Tons.	Rig.	Belonging to	Spot where Wrecked.	No. of Lives Lost
1816						
7 April	Peggy					
11 November	Admiral Nelson			Dysart	Greyhope, opposite Roadhill Aberdeen	
20 "	Friends		Sloop	Leith	Ythan mouth	
28 December	Margaret			Aberdeen	Cruden Sands	
1817						
13 January	William			Sunderland	Rattray-head	
18 March	Brothers			Aberdeen	Ythan-mouth	
3 September	Jean			Thurso	Near Peterhead	
30 October	Gibraltar		Brig	Aberdeen	Blackdog	
14 November	William and Mary		Sloop	Sunderland	Near Peterhead Bulls	
14 "	John		Schooner	Greenock	Near Cruden	
18 "	Berry Castle			Aberdeen	Scotstown-head	
20 "	Marchioness of Huntly		Ditto	Fochabers	Boddam Rocks	
4 December	Ford			Sunderland	Forvie Sands	
14 "	Mary		Brig	Newcastle	Collieston Rocks	
18 "	Mary and Ann			Cullen	Near Peterhead Harbour	Pilot Lost
1818						
4 January	Expedition			London	Near Blackdog	All Lost
10 "	Perseverance		Brig	Aberdeen	Belhelvie	Pilot Lost
4 March	Argo		Schooner	Alnmouth	Pennyfauld	All Lost
" "	Hero		Sloop	Stonehaven	Rattray-head	
12 "	Elbe		Sloop	Aberdeen	Ditto	
8 May	Boelune		Sloop	Inverness	Ditto	
18 August	Sarah Ann		Brig	North Shields	Ditto	
1819						
25 January	Abundance			Aberdeen	Collieston	Pilot Lost
"	Hunter			Ditto	Forvie Sands	
3 February	Prince of Wales			Cardigan	Cairnbulg Point	All Lost
13 March	Lord Fife		Sloop	Macduff	Scotstown-head	
2 October	Helen		Brig	Dundee	Rattray-head	
28 December	Saint George			Limekilns	Scotstown-head	
1820						
April	Hynd		Brig	Dundee	Rattray head	
5 October	Chance			Montrose	Ditto	
1821						
8 March	Hebe		Ship	Hull	Ythan-mouth	
9 May	Ann and Isabella			Stonehaven	Stonehaven Bay	
22 November	Hope		Brig	Leith	Rattray Briggs	
18 December	Harmony		Ditto	Ditto	Rattray-head	
1822						
1 March	John		Sloop	Macduff	Kinnaird-head	
22 September	George and Ann		Ditto	Aberdeen	Forvie sands	
26 "	Edward	224	Brig	Leith	Near Peterhead	
6 October			Sloop		Rattray head	
22 November	Mary			Leith	Scotstown-head	
1823*						
February	Lord Nelson			Portsoy	Scares of Cruden	All Lost.

* From this period till 1828, no List was kept. The following, since 1828, is taken from the List kept at the Buchanness Light-house, situated on the south side of the Bay of Peterhead, within about two miles of the Harbour.

List of Wrecks in the vicinity of Peterhead, 1828–46.—*continued*

Date.	Name.	Tons	Rig.	Cargo.	Belonging to	From	Bound to	Wind	Weather	Spot where Wrecked	No. of Lives Lost.	Estimated Value of Vessels	Estimated Value of Cargo	Remarks. Supposed cause of Wreck. Had Pilot on board
												£	£	
1828														
2 October	Wilson	270	Brig	Timber	Blyth	Memel	Dundee		Hazy	Rattray-head		6,358	1,000	The actual Loss on Ships' Cargoes cannot be shown.
27 November	Betsey	60	Sloop	Ditto	Spey	Spey	St. David's and Leith	S.W.	Fresh	South-head, Peterhead		250	100	
1829														
7 December	Hawk	36	Ditto	Stoneware, &c.	Aberdeen	Gainsborough	Aberdeen	S.S.E.	Hazy	South side Peterhead Bay		300	350	
28 September	Fraser	66	Ditto	Machinery	Blyth	Newcastle	Liverpool	N.W.	Stormy	North-head, Peterhead		300	3,000	
11 November	Swan	51	Ditto	Coal	Hartlepool	Sunderland	Buckie	S.E.	Slight Gale.	Blackhill, Cruden	1	393	80	
" "	Bellona	48	Ditto	Ditto	Fraserburgh	Ditto	Fraserburgh	Ditto	Ditto	Scares, ditto		360	50	
1830														
28 August	Saturnus	85	Schooner	Tar	Raseo in Finland	Christiansteth	Liverpool	N.E.	Hazy	South Bay, Peterhead		400	250	
1831														
2 February	Surprise	73	Sloop	General cargo	Peterhead	Belfast	London	W.	Tempest.	North-head, Peterhead	5	500	3,000	
13 March	Pomona	75	Schooner	Coal	Ditto	Sunderland	Peterhead	S.S.W.	Hazy	Near North Harbour, ditto		602	60	
8 April	Banffshire	85	Smack	General cargo	Banff	London	Banff	S.E.	Slight Breeze	Scotstown-head		1,600	2,000	

Date.	Name.	Tons.	Rig.	Cargo.	Belonging to	From	Bound to	Wind.	Weather.	Spot where Wrecked.	No. of Lives Lost.	Estimated Value of Vessels.	Estimated Value of Cargo.	Remarks, Supposed cause of Wreck. Had Pilot on Board.
												£.	£.	
7 September	Hero	67	Sloop	Lime and lead	Limekilns	Sunderland	Dingwall	S.S.E.	Hazy	South-head	..	850	75	
1832														
10 October	..		Boat	..	Boddam	Boddam	Peterhead	W	Squall	Upset in Bay	7	..	..	
16 November	Captain	78	Schooner	Coal	Aberdeen	Sunderland	Aberdeen	S.E.	Gale	Bullers of Buchan	5	400	50	
30 ,,	Henry	140	Brig	Slates	Sunderland	Cornwall	Sunderland	S.	Slight do.	North of Peterhead	..	800	1,050	
1833														
8 November	Friends	72	Schooner	Ballast	Wick	Kirkwall	Peterhead	N.W.	Hazy	Back of Breakwater		400	..	
8 December	Friendship	62	Sloop	Timber	Inverness	Inverness	Carron	S.	Ditto	Near South Harbour ditto	..	400	40	
1834														
22 October	Jean	43	Ditto	Ditto	Fraserburgh	Dunbar	Rosehearty	N.W.	Ditto	Back of ditto	..	300	30	
4 November	John	76	Schooner	Coal	Newcastle	Newcastle	Cromarty	S.S.W.	Thick	Kirkton-head	..	300	40	
,, ,,	Unknown	60	Ditto	..	..	..	..	Ditto	Ditto	Rattray-head	All lost	..	..	
1835														
27 June	..	..	Pilot Boat	..	Peterhead	Peterhead	Foreign Vessel with Signal	N.	Swell	South-head, Peterhead	5	..	..	
18 November	Jean	..	Boat	Fish	Ditto	Fishing	Peterhead	N.E.	Gale	North of Peterhead	6	20	..	
1836														
3 March	London Packet	65	Sloop	General cargo	Aberdeen	Aberdeen	Leith	W.	Hazy	South head, ditto	..	600	1,000	
25 July	Jean	27	Ditto	Herrings	Montrose	Peterhead	Montrose	S	Ditto	North, ditto	..	150	200	
6 October	Sincere	30	Ditto	Ballast	Peterhead	Ward of Cruden	Peterhead	E.	Clear	Ward of Cruden	..	250		
13 ,,	Helen	84	Schooner	Timber	Ditto	Southampton	Ditto	S.E.	Breeze	Bathe, South Harbour	..	700	350	
14 November	Princess William	42	Sloop	Herrings	Cullen	Cullen	London	W	Thick	Rattray-head	..	200	400	
1837														
10 February	Glasgow Packet	73	Ditto	General cargo	Aberdeen	Aberdeen	Glasgow	S.S.W.	Gale	Near South Harbour	..	600	..	
19 April	Prosperous	20	Ditto	Ditto	Peterhead	Ditto	Peterhead	E	Foggy	South-head, Peterhead	..	150	250	
1838														
11 August	Diana	66	Ditto	Coal	Spey	Aberdour	Garmouth	S.S.W.	Ditto	Ditto	..	700	30	
23 February	Marianne	67	Schooner	General cargo	Peterhead	Peterhead	Lerwick	S.E.	Breeze	Ditto	..	700	60	
25 October	Forth	66	Sloop	Coal	Inverness	Newcastle	Inverness	Ditto	Gale	Kirkton-head	4	300	30	
27 November	Reciprocity	74	Schooner	Lime	Peterhead	Sunderland	Peterhead	S.S.W.	Ditto	Near North Harbour	..	700	70	
,, ,,	Hunter	60	Sloop	Coal	Ditto	Ditto	Lossiemouth	Ditto	Ditto	Near South ditto	..	400	70	
1839														
7 January	Courier	48	Ditto	General cargo	Ditto	Glasgow	Aberdeen	N.W.	Ditto	South of Peterhead	..	350	600	
21 ,,	Sarah	69	Schooner	Wheat	Liverpool	Newcastle	Dundalk	S.S.E.	Ditto	South Bay, ditto	..	200	2,000	
25 May	Robert Gordon	70	Ditto	Lime	Sunderland	Sunderland	Moray Firth	W.N.W.	Ditto	Near Peterhead	8	1,000	140	
8 September	St Andrew	67	Ditto	Rock Salt	Kirkcudbright	Liverpool	Fisherrow	S	Clear	Near South Harbour	..	500	80	
30 October	James and Mary	71	Ditto	Coal	Peterhead	Sunderland	Peterhead	S.E.	Hazy	Ditto	—	500	70	
1841														
17 February	William Gray	110	Ditto	Ditto	Ditto	Inverkeithing	Oporto	Ditto	Foggy	Cruden Bay	..	1,000	200	
20 May	Ida	163	Ditto	Wheat	Stettin	Stettin	Liverpool	S.S.W.	Hazy	Rattray-head	—	2,000	2,400	
6 June	Forrest	39	Sloop	Coal	Findhorn	Sunderland	Findhorn	N	Gale	Salthouse, ditto	..	300	40	
6 August	Harriston Chalton	400	Barque	Ditto	Whitby	Ditto	America	S.S.E.	Foggy	Kirkton, ditto	..	5,000	300	
1842														
6 January	William Tuttons	174	Brig	Ditto	Kincardine	Alloa	West Indies	S.	Breeze	Rattray, ditto	..	3,000	70	
16 October	Good Intent	31	Smack	General cargo	Peterhead	Aberdeen	Peterhead	N.W.	Gale	Salthouse, ditto	..	150	250	
1843														
14 December	Snyders	210	Barque	Timber	Newcastle	[illegible]	Hull	S.W.	Do. Hazy	Scotstown, ditto	..	2,300	700	
1845														
18 July	Queen	382	Steamer	General cargo	Aberdeen	Inverness	Aberdeen	N.W.	Foggy	Boddam	..	18,000	1,250	
10 November	Liverpool Packet	81	Schooner	Ditto	Ditto	Aberdeen	Glasgow	S.E.	Gale	Near Peterhead	..	700	..	
1846														
5 November	Brothers Increase	25	Sloop	Ditto	Peterhead	Ditto	Peterhead	S.W.	Ditto	Peterhead Bay	..	..	..	

APPENDIX C.

PETERHEAD.

No. 216.
Vessels taking refuge in Harbours, 1833-45.

No. 216.

Statement showing the number of Wind-bound Vessels, with their Tonnage, which have entered the Harbours of Peterhead for refuge from the 1st of January, 1834, to the 1st of January, 1846.

Date.	Number of Ships.	Tonnage.
In 1834	290	17,303
1835	298	15,808
1836	304	15,520
1837	258	13,267
1838	200	9,690
1839	206	10,934
1840	217	11,358
1841	211	10,989
1842	207	11,840
1843	180	9,518
1844	170	9,316
1845	232	14,085
	2773	149,628

E. E. JAMES MITCHELL.

No. 217.

Return of Income and Expenditure for the Years 1841-2-3.

INCOME.

Heads of Income.	1841 £.	1841 s.	1841 d.	1842 £.	1842 s.	1842 d.	1843 £.	1843 s.	1843 d.
Tonnage duties on vessels	631	7	5	610	12	5	604	13	1
Wintering ditto	34	15	0	39	12	1	44	16	10½
Duties on timber	187	0	0	116	16	9½	150	2	10
,, on salt	324	13	1½	325	10	5½	264	18	8½
,, on produce of whale-fishery	98	12	8	68	16	11½	195	14	8½
,, on produce of herring do.	753	16	7½	661	1	0	920	16	10½
,, on bone manure	107	7	10	103	8	9	36	18	6
,, on coals	248	15	5½	231	7	11	256	19	10½
,, on lime	51	9	10½	34	6	11½	49	4	0
,, on grain	280	6	0½	241	19	0½	327	17	11½
,, on meal	35	18	3	53	19	1	24	5	5
,, on potatoes	11	6	2	4	6	0	1	12	0
,, on sundry goods imported.	234	6	7	210	15	9	228	7	7½
,, on ditto . . exported.	104	4	4	52	5	3½	89	1	5½
,, on warehousing of goods	9	18	6	4	10	3	6	11	8
,, on ballast	201	1	0	191	3	3	150	17	0
Graving or dry dock dues	136	16	9	92	12	0	112	6	6
Rents of ship building and timber-yards and houses	90	12	6	109	7	9	112	5	6
Interest on debt due to the Trust.	4	18	10	3	15	2	4	0	0
Total . . . . £	3,547	4	11½	3,156	6	11	3,581	10	7

EXPENDITURE.

Heads of Expenditure.	1841 £.	1841 s.	1841 d.	1842 £.	1842 s.	1842 d.	1843 £.	1843 s.	1843 d.
Salaries	208	2	10	219	13	3	210	14	1
Rents and feu duties	25	12	11	25	10	0	25	11	11
Repairs and works	339	5	2	745	2	1½	465	7	0½
Excavating & cleaning	130	15	4	229	4	7½	173	16	9
Lighting harbours	14	10	10	15	7	6	13	7	4
Cartage of ballast	69	11	4½	58	14	8½	59	11	11½
Sundries.	91	13	3½	97	19	8½	68	8	7
Income tax, exceeding what has been retained from interest	..			..			39	17	1
Interest on money borrowed	1,578	12	11	1,504	16	2	1,478	6	11
Annuities payable on ditto	93	12	7	93	12	7	93	12	7
Total. . . £	2,551	17	3	2,990	0	8	2,628	14	3

The dues are levied under authority of Act 7 & 8 Geo. IV.
Debt due on the 1st of January, 1846, 33,876*l*.

R. GRAY, *Provost.*
ANDREW BOYD, *Clerk to the Trustees of the Harbour.*

FRASERBURGH.

Appendix C.

Fraserburgh.

No. 218.

Return to Order of the House of Commons of 9th August, 1844.

No. 218.
Return to order of House of Commons 9th August, 1844.

Fraserburgh, February 11, 1845.

Sir,

In answer to your circular of the 1st instant I am directed by the Commissioners of the Harbour of Fraserburgh to acquaint you that, previous to the year 1818, the said Commissioners, in the management of the Harbour Works, acted as members of the Town Council of Fraserburgh, elected by the Superior, Lord Saltoun.

In 1818 the Managers or Town Council, having in contemplation considerable improvements in the said harbour, applied for and obtained the Act of Parliament, 58 Geo. III. c. 25, intituled "An Act for repairing and maintaining the Harbour of the Burgh of Regality of Fraserburgh, in the County of Aberdeen," under which they were authorised to levy certain duties in order to the liquidation of the debt contracted in the execution of the aforesaid works; under this Act the said Town Council acted as Commissioners until the year 1839, when, the powers conferred by the above-recited Act having been found insufficient to enable the said Commissioners to carry out certain then contemplated improvements, the former Act was repealed, and the Act 2 & 3 Vic. c. 65, intituled "An Act for further improving and maintaining the Harbour of the Burgh of Regality of Fraserburgh, in the County of Aberdeen," was obtained, and under this Act the Fraserburgh Harbour Commissioners at present act.

Referring to said Harbour Works, I enclose—

- I. Excerpt from a Report, by James Walker, Esq., Civil Engineer, London, to T. S. Brickwood, Esq., Exchequer Loan Office, London, of date the 23rd of September, 1840; as also
- II. Excerpt from a Letter, addressed by John Gibb, Esq., Civil Engineer, Aberdeen, to Lewis Chalmers, Esq., Acting Chief Magistrate of Fraserburgh, of date the 25th day of September, 1837; also
- III. Letter, by the said Lewis Chalmers to Lord Saltoun, of date the 6th day of August, 1844, containing Excerpt from a Report by Robert Stevenson, Esq., Engineer to the Commissioners of the Northern Lighthouses; as also
- IV. Reduced plan of the Harbour of Fraserburgh, with sections of the present South Pier, by Robert Stevenson, Esq., Civil Engineer, dated in 1818; and
- V. Plan of the Harbour of Fraserburgh, showing the contemplated improvements, by James Walker, Esq., Civil Engineer, dated in 1838.

The Fraserburgh Harbour Commissioners are in possession of no written complaints as to the defects of the Harbour of Fraserburgh.

I have, &c.,
Alex. Begg,
Clerk to the Fraserburgh Harbour Commissioners.

Hon. H. Manners Sutton, Whitehall, London.

No. 219.

Report of Robert Stevenson, Esq., C E., *relative to the Harbour of Fraserburgh, and on a New South Pier.*

No. 219.
Stevenson, on the Harbour and a new South Pier.

Edinburgh, January 31, 1818.

From information received accidentally by the reporter regarding the origin and progress of the harbour of Fraserburgh, it appears that this town is of very considerable antiquity, but till a comparatively modern date its harbour was merely an open bay, like that of most of the early harbours of Scotland, having no piers for the shelter or berthage of decked vessels. At that time it was consequently resorted to only by fishing boats and small craft, which could be easily drawn upon the sea beach out of the reach of the waves. From the naturally convenient position of the bay of Fraserburgh, for the shipping of the North Sea, the Moray and Cromarty Firths, and also the coasting trade of the north of Scotland, Fraserburgh, even prior to the erection of piers, was at certain times considered a place of refuge for small craft in the stormy and tempestuous weather with which the shipping of this coast is but too often visited. Representations from the shipping interest having accordingly been made to the noble family of Saltoun, as superior of the town, pointing out the great advantages which would follow the erection of piers, and the formation of a proper harbour at Fraserburgh, these operations were at length taken into serious consideration, and piers at a very considerable expense were extended into the bay of Fraserburgh, enclosing an area of about 1 A. 24 P., as appears from the accompanying plan, and affording ample berthage for shipping of that period. A very considerable trade was accordingly soon afterwards established in this town and neighbourhood, which also became the occasional resort of numerous "herring busses," and was frequented by many fish-curers who settled there, and have ever since continued to increase in number, so that Fraserburgh is now considered one of the principal fishing stations on the eastern coast of Scotland. It has also been considered so excellent a situation for wind-bound vessels that, about 12 or 15 years ago, a very general desire was expressed by the shipping and mercantile interests of the numerous ports of the Moray Firth and Firth of Forth, and also on the English coast as far as Newcastle and Sunderland, for the enlargement and improvement of the harbour. A plan was accordingly obtained for this purpose from Mr. Rennie, whose professional celebrity is well known; and the whole of this measure having also met with the approbation of the Parliamentary Commissioners for the improvement of the Highlands, the sum of 5,820*l.* was advanced by the public, and the remaining sum then supposed to be necessary to complete the works was furnished by the noble proprietor, the heritors of the town, and others, for this most useful undertaking. These new works were entered upon in the year 1807, and by the year 1811 the sum of 11,351*l.* 18*s.* 6*d.* was expended in the erection of a new northern

APPENDIX C.

FRASERBURGH.

No. 221.
Stevenson, on the Harbour and a new South Pier.

pier, extending into the bay for 770 feet, being 410 feet farther than the original piers. This work it is believed has been executed in a very substantial manner, and to the satisfaction of Mr. Telford, engineer for the Parliamentary Commissioners. But as this pier extends, as already mentioned, 410 feet farther seaward than the present southern pier, it has been found that, unless the original plan of this extended harbour, or some modified plan upon similar principles, be executed, in the form of a covering pier, the whole sum of 11,251*l.* 18*s.* 6*d.*, already expended on the northern pier, will be entirely lost to the public.

In certain directions of the wind it is found that the shipping frequenting this harbour are not only much exposed to the run of the sea, from the unprotected and disjointed state of the pier, but that great quantities of sand are carried from the bay into the interior of the harbour, which render it comparatively of little use even for small coasting vessels. This is the more to be regretted as at the northern pier-head there is a depth of water not less than about 5 or 6 feet at low water of spring tides, to which if we add the rise of these tides in this harbour (that is from 14 to 16 feet), it will be found that the new harbour of Fraserburgh, when completed, will command from 19 to 22 feet of water, a consideration of the last importance for shipping, as such a depth of water is nowhere to be met with in the harbours on the eastern coast of Great Britain, excepting where there are rapid rivers, which render their access difficult and dangerous.

Under these circumstances the noble superior and magistrates of the town have applied to the reporter to give a design for building a new southern pier upon a scale, if possible, more modified than the southern pier originally intended by Mr. Rennie, and delineated by dotted lines upon the accompanying plan, which he has now the honour of submitting for their consideration. He regrets, however, that he cannot confine the expense, as requested, to the sum of 6,000*l.* (the fund quoted as being within the reach of the magistrates), it being impossible to lessen the extent of the southern pier further than he has done, as, in order to be effective, it must be brought out nearly to the line of the head of the northern pier, at a fixed point. He must, therefore, submit an abstract estimate, amounting to 10,920*l.* 10*s.*, as the lowest fund at which, in his humble opinion, it would be prudent or advisable to embark in this work.

The proposed new southern pier, as now designed by the reporter, is 140 feet less in extent than the pier originally intended by Mr. Rennie. It will, however, be found to answer all the purposes of a covering pier, with equal if not greater advantage. By examining this pier, and comparing it with the original design in dotted lines, it will be found that the pier upon the modified scale now recommended by the reporter presents the least possible obstruction to the passage of vessels entering the harbour, while at the same time it effectually covers the area or interior of the harbour towards the south. This plan of a new pier has been designed of the simplest construction, and admits of being estimated at the lowest rates at which good masonry can be executed from the expensive quarries of Aberdeenshire. From experience in works of this kind, the reporter, as already stated, does not feel himself at liberty to lessen the amount of the annexed estimate, as he cannot modify the extent of the work with a due regard to the stability of a pier in so exposed a situation as that of Fraserburgh. Nor need this seem strange, as it appears that there was expended in the erection of the northern pier the sum of 11,251*l.* 18*s.* 6*d.* That pier is no doubt 140 feet longer than the proposed new southern pier, but it has been found to be inconveniently narrow for cartage and the discharge of ships, and the reporter has therefore designed the new pier with a breadth of 30 feet of roadway instead of about 20 feet, which is the breadth of the northern pier. This will increase the expense to the estimated sum of 10,920*l.* 10*s.*, but will make the pier very suitable for trade.

From the official situation of the reporter as engineer to the Commissioners for the Northern Lighthouses, he has occasion annually to visit this coast, and has otherwise much opportunity of knowing the advantages held out to the general interest of shipping by the formation of such a harbour as is now proposed at Fraserburgh, situate at the entrance of the Moray Firth, and consequently in the course of all vessels bound to or from the north of Scotland, and all vessels frequenting the Caledonian Canal. It should also be noticed that Fraserburgh harbour is in the immediate vicinity of Kinnairdhead Lighthouse, one of the public lights upon the coast, and is therefore a point that is steered for by all vessels in those latitudes going coastwise or bound over seas. Perhaps enough has here been said upon the utility of the harbour of Fraserburgh, a subject which has been well ascertained and generally admitted if we may judge by the criterion of the former grant of public money allowed for the erection of its northern pier.

To the Right Hon. Lord Saltoun, &c., Superior,
and the Magistrates of Fraserburgh.

ROBERT STEVENSON.

No. 220.

Report by JOHN GIBB, Esq., C.E., *on the best means of improving the Harbour, and Estimate of Extension of Pier.*

No. 220.
Gibb, on improving the Harbour, and Estimate.

SIR,

Aberdeen, September 25, 1837.

IN compliance with your previous communications, I reached Fraserburgh on the 14th instant, when the tides were in their best state; and on this and the following day I carefully examined the harbour and adjacent shore at high and low water, and took the necessary measurements and soundings to enable me to ascertain the depths and nature of the bottom in various directions for a considerable depth seaward.

After noticing briefly the extensive operations which have been performed to improve this harbour, and the disadvantages with which it is still attended, I shall proceed to state what appears to me as still necessary to be done to render it fitting for the rapidly increasing trade, especially by steam navigation, which cannot be successfully carried on, unless where there are landing-quays and a sufficient depth of water to admit of steamers coming alongside at all times of the tide. Notwithstanding there has been already built, first, the north pier, 840 feet, with berthage on one side; second, south pier, 700 feet, with berthage on one side; third, middle jetties to the extent of 700 feet, with berthage on both sides, being in all 2940 feet of quay berthage, and enclosing an area of about 6½ acres Scotch—owing to the exposure of the inside of the north pier, and one side of the opposite jetty, there are not above 1650 feet of this berthage available in stormy weather.

It is therefore with the view of rendering the whole of the existing berthage available at all times, and affording deep-water berthage to steamers and a larger class of shipping than can at present approach this port, that I recommend the extension of the northern pier, which would give, at ordinary spring-tides for a considerable distance in clear ground, a depth of about 24 feet at high-water.

No. 220.
Gibb, on improving the Harbour, and Estimate.

This harbour is situated in a bay of about three miles long and one broad, bounded on the north by the promontory called Kinnaird's Head, on which there is an excellent lighthouse whereon a light is exhibited from sunset to sunrise throughout the year, about 680 yards north of the pierhead. The bay is bounded on the south-east by a projecting headland called Cairnbulg. The locality of Fraserburgh Harbour is therefore particularly favourable as a harbour of refuge, as well as for the fisheries, which are there extensively carried on; and, being situated at the extremity of an extensive and highly-cultivated grazing district, affords every facility for an increasing trade, especially in cattle, which are now extensively exported, fit for market, from the northern and eastern coast of Scotland, whenever the large steamers can find accommodation for receiving them on board without delay; thus giving to the grazing farmer the advantage of feeding his stock on the ground in place of disposing of them as heretofore in a lean state to an immediate agent to be carried over a circuitous route by land.

The burgh of Fraserburgh, increasing in population, must also increase the demand for coal and lime, which have all to be brought seaward for the supply of the town and a large surrounding country. If the judicious mode of management which has hitherto been pursued in the affairs of this burgh be continued, the evidence of the past gives us every reason to anticipate a large addition to the annual revenue from the extension of the pier as proposed by the accompanying plan; while it will be a great advantage to those concerned in shipping, and a solace to the weary mariner when he makes the land after a tempestuous voyage.

I estimate the extension of the pier and other works connected therewith, agreeable to the accompanying plan, at 8902*l.* 14*s.* 8*d.*

I am, &c.,
JOHN GIBB.

Lewis Chalmers, Esq., Chief Magistrate.

No. 221.

Report by JAMES WALKER, Esq., C.E., F.R.S., *on the Capabilities of the Harbour, and Estimate for the New Works.*

September 23, 1840.

No. 221.
Walker, on the capabilities of the Harbour, and Estimate for new Works.

SIR,

YOUR letter of the 17th July informs me of an application from the Commissioners of Fraserburgh Harbour for a loan of 10,000*l.* to effect certain improvements in their Harbour, and desires my opinion on the practibility, utility, and probable expense of the proposed works, with the time necessary for their completion, the probable revenue to be derived therefrom, and generally on any points which in my judgment may be proper to enable the Commissioners to consider the expediency of advancing the sum applied for.

As the improvements referred to in Mr. Chalmers's answer to your interrogatories, and for which an Act was obtained in 1839, were designed and estimated by me, a journey to the place on the present occasion was not required.

Fraserburgh is situated on the most north-easterly point of Scotland, and at the entrance of the Moray Frith, being at the eastern termination of the Caledonian Canal, and also at the point where vessels going north or south, whether intended to enter the canal or otherwise, have to change their course. A good harbour at Fraserburgh would be very useful indeed to vessels caught in gales of wind, as it would prevent their running to the Forth on the one hand, or Cromarty on the other; Montrose, the best harbour between Fraserburgh and the Forth, being attended with difficulty as a harbour of refuge.

The proposed improvements do not embrace such national objects, but if carried into full effect these would make the harbour occasionally useful as a refuge in distress and to wind-bound vessels.

The main object of the present proposed improvements was to give security to vessels employed in the trade of the port and adjacent country, on entering and while lying in the harbour; for these purposes it will I think be sufficient. The importance of Fraserburgh harbour is greater than from the money amount of its trade and receipts may at first sight appear. From its exposure to northerly and easterly gales from the German Ocean, and its rugged rocky shores increasing the danger, from shipwreck, to mariners, it has claims also on the score of humanity.

The two present harbours contain an area of nearly 8 acres imperial, but one of them, the north harbour, is so exposed as to be comparatively of little value and little used. The present harbour will only accommodate vessels drawing from 10 to 13 feet, and they must enter and leave at high water, there being only 4 feet during the low-water of spring-tides at the entrance, while the inner part of the harbour is dry; notwithstanding these disadvantages it is occasionally much crowded, especially during the fishing season.

A new outer harbour (see plan) is proposed to be constructed of the stone from the neighbourhood, the outer or sea face sloping as a breakwater, the inner face built as a wall for vessels to lie alongside; to contain an area of 2 acres. The proposed harbour will have 9 feet at its entrance low-water spring, and 13 feet at low-water neap tides; 21 feet at high-water spring, and 17 feet 6 inches at high-water neap tides; so that vessels drawing 12 feet would be able to enter for shelter at the low-water of neap tides, and large vessels at every half-tide.

As respects practicability, the foundation is good, the materials abundant; and the only difficulty likely to arise is from the exposed situation and the storms, which affect the contingencies and cost; but there is, I apprehend, no reason to doubt the practicability of the work.

My estimate of the new works, with 12½ per cent. contingencies, was .	£15,500
The purchases were estimated by a Surveyor at	4,500
Making a total of	£20,000

And although it appears, from Mr. Chalmers's statement, that the necessary purchases may be made for 2000*l.* in place of 4500*l.*, still for present purposes it may be better to take 20,000*l.* as the estimate.

J. WALKER.

J. S. Brickwood, Esq.,
Exchequer Loan Office, London.

No. 222.

Letter from the Chief Magistrate to LORD SALTOUN *on the Capabilities of Fraserburgh as a Harbour of Refuge, with Extract from* MR. STEVENSON'S *Report thereon.*

No. 222.
Chalmers's Letter, and Extract from Stevenson's Report on capabilities of Harbour for refuge, &c.

MY LORD,

Fraserburgh, August 6, 1844.

I AM very glad to see that a motion has been made in Parliament, and is likely to be attended to, for the appointment of a Commission to inspect the whole harbours on the coast of Great Britain, with a view to the erection of harbours of refuge for vessels in distress; because by such a measure those harbours *only* which will be of the greatest importance to the shipping interest in general, by their easy access, safe accommodation, and which will be least expensive to the public, will be selected.

Of these *harbours*, that of Fraserburgh is considered to be among the first; and this is the opinion of several eminent engineers, particularly Robert Stevenson, Esq., Engineer to the Commissioners of the Northern Lighthouses, who, from his personal inspection *annually* of that part of the east coast of Scotland for upwards of 40 years, and his general information on such a subject, must be well qualified to judge of its capabilities. The following excerpt from a Report which he made more than 20 years ago will show pretty clearly that he considered Fraserburgh capable of being made the *best tide-harbour* on the north-east coast of Scotland. It is as follows:—

"By the slightest inspection of a map or chart of the German Ocean, or North Sea, it will be observed that vessels overtaken by a gale of wind from the north-east or south-east have only the Frith of Forth and Moray and Cromarty Friths to resort to in a storm, all other ports and inlets of the sea upon the British side being respectively shut up and rendered inaccessible with these winds. It may further be observed that the land between Buchanness and Peterhead to the south, and Kinnaird's Head or Fraserburgh towards the north, forms a prominent shore between the great estuaries of the Friths of Forth and Moray, and becomes a turning-point in the navigation of this port, and is also the land most generally made by ships southward-bound from the Baltic and higher latitudes. Other circumstances in connexion with these might be mentioned as tending to show the advantage of a good harbour at Fraserburgh and at Peterhead, as these two harbours go hand in hand in rendering essential service to the shipping and commercial interest of the eastern coast of Great Britain. In proof of this it may still further be noticed that between Fraserburgh and Peterhead, at about the distance of two miles from the shore, there lie several sunken rocks, viz. Rattray Brigs, Cairnbulg Brigs, and Cruden Scares; so that this part of the coast is now considered by far the most dangerous between the Fearn Islands and the Orkneys since the erection of lighthouse on the 'Bell Rock.' It is therefore obvious that the mariner must feel much reluctance in passing this dangerous part of the coast oftener than once upon a voyage; hence, when a vessel has got to the northward of Fraserburgh and meets with an adverse wind, it is of importance to her safety to get into that harbour instead of again passing these *foul grounds* in bearing away for the *Frith of Forth*, as Peterhead *cannot* be entered when *Fraserburgh would be perfectly acessible.* In this manner also the southern-bound traders find an asylum instead of passing these dangerous shores. These considerations are of great importance to the prosperity of commerce, and the safety of coasting-vessels, which are too often neither well manned nor stoutly rigged, and in general are so heavily loaded as to be hardly seaworthy. In this view of the case there can be no doubt that the completion of the south pier of Fraserburgh Harbour, besides giving facility to commercial enterprise, would be the means of saving many useful lives and much valuable property. In this respect it may be stated that the harbours of Fraserburgh and Peterhead are to this part of the coast what Ramsgate and Dover are intended to be to the shipping of the British Channel. The prosperity of this place (Fraserburgh) depends almost entirely upon its fishings and its shipping, and were the piers completed it would become a place of great importance. But aside from all local or partial views of this subject, I now write upon the broad basis of public utility.

"Upon this harbour I understand there has already been laid out in the erection of the eastward or sea pier about 11,000*l.* This sum has been made up by the Parliamentary Commissioners, and by a subscription chiefly from the family of Saltoun. From the state of the works I presume that 6000*l.* would still be required for clearing the interior of the harbour of rocks and for the erection of a south pier. In the present state of the harbour of Fraserburgh, although there are about 6 feet at the new pier-head at low-water, and no less than 20 feet at high spring-tides, yet, by the projection of the north pier beyond the head of the old south pier, the harbour is rendered quite open and defenceless towards the bay, and, in its present state, the sum expended may be considered as lost to the public, while the pier already built has a very trying and unfair exposure to the action of the waves both on its outward and inward walls. I am, however, humbly of opinion that the erection of the south or covering pier, and the consequent enclosure of a large space agreeable to Mr. Rennie's design, would render the harbour of Fraserburgh by much the *best tide* harbour on the north-west coast of Scotland between it and Burntisland.

"The situation of Fraserburgh on this part of the coast of Aberdeenshire is of great importance to the shipping interest in general; and its position at the immediate entrance of the Moray and Cromarty Friths, at the northern extremity of an extensive bay, containing an anchorage-ground for ships with off-shore winds, will be found to be happily chosen for the site of a harbour of great resort for wind-bound ships. Here vessels are neither in danger at the apex of a deeply-indented bay, nor molested by the inconstant current or flow from a rapid river, capable at the same time of commanding a depth of water answerable for the *largest merchantmen* or even the smaller classes of his Majesty's ships of war.

"Let it be considered for a moment how a harbour unencumbered with numerous sandbanks would be valued on the southern coast, between the Humber and Portsmouth, and say whether such an accommodation be not worth the trifling additional sum necessary for completing this harbour.

"It were easy to multiply cases, and to draw inferences, to show why the harbour of Fraserburgh, already more than half built, should be completed; and that it is a fit subject for a further grant towards its completion; but what has been said may suffice. Trusting that the public nature of this Report will be my apology for dwelling so long on the subject, I need say little more; but I must not conclude without mentioning that the harbour of Fraserburgh, when completed, will be in every way calculated to be of great service to vessels frequenting the Caledonian Canal, as a place of rendezvous in bad weather and adverse winds. What I have stated regarding Fraserburgh Harbour, which I have an opportunity annually of seeing in the course of my circumnavigation as Engineer for the

No. 222.
Chalmer's Letter and Extract from Stevenson's Report on capabilities of Harbour for refuge, &c.

Commissioners of the Northern Lighthouses, is from my own actual observation and experience, and with a view to show the utility of this measure to the general trade of the country."

Such was the opinion of Mr. Stevenson in 1817. The improvements recommended by him were completed in 1819 and 1820; and since then another interior pier has been erected, and other improvements made, at an expense of more than 14,000*l.* (raised entirely from the revenue of the harbour), which has been proved to be of great utility, not only for tranquilizing the harbour, but for additional berthage; and Mr. Stevenson's anticipations have been realized to the fullest extent. The Commissioners, however, in the year 1837, being wishful to obtain a greater depth of water, whereby *large* vessels might enter at all times of tide, proposed building an outer pier or breakwater, to the eastward of the north pier-head, and to borrow money on the credit of the harbour for that purpose. But having made application to the Exchequer Loan Commissioners for such a loan, it was stated by them, that, as dues could not legally be demanded from vessels taking shelter in the *Outer Harbour* if built under the then Act of Parliament, the loan could not be granted. Being so situated, they resolved to make every effort to obtain the necessary funds for the erection of such a pier as might be thought of the greatest benefit to the public. James Walker, Esq., Engineer, London, was applied to in 1838 to make a survey and plan of the harbour and of said outer pier, which he did, the expense of which, in whole, with the grounds required, was estimated at 17,000*l.*; he thought 20,000*l.* might be required; but the requisite properties have all been purchased, and we find that the 17,000*l.* would have done the whole, and for which a depth of water at the pier-head would have been obtained at *low* water ordinary spring-tides of nearly 9 feet, at high water 21 feet, and at about neap tides low water 13 feet and high water 18 feet; but by carrying out the pier a little farther, water would be obtained which would be sufficient for almost any size of vessels and at any time of tide. The Commissioners under these circumstances were induced to apply for, and obtained, an Act of Parliament in 1839, to build said pier, and exact certain rates of dues to enable them to do so, but the necessary funds for which have not yet been obtained; and the Commissioners hope that Government, seeing that it would be a great national benefit, will take it up, and allow the necessary funds to make it a *harbour of refuge*, the revenue from which to go annually, after payment of keeping up the piers, to pay the interest and *principal.*

I humbly hope you will have the goodness to do all in your power to bring the harbour of Fraserburgh under the notice of Government, as being considered by experienced persons by far the fittest as a harbour of refuge between Burntisland and Cromarty Frith.

I remain, &c.,

The Right Honourable Lord Saltoun, &c. &c. LEWIE CHALMERS, *Chief Magistrate.*

No. 223.

No. 223
Fishcurers' Memorial on the want of accommodation for fishing-craft.

The Memorial of the Fishcurers and Merchants, &c., in Fraserburgh, to the Honourable the Baillie and Commissioners for the Harbour of Fraserburgh, on the want of accommodation for the Fishing-boats,

HUMBLY SHEWETH—

THAT the memorialists, considering that the herring fishing is the staple trade of this port, and that on its successful prosecution the prosperity of the place mainly depends, view with much satisfaction the great increase of late years in the number of boats fishing at the port.

That while the memorialists have to congratulate the Harbour Board in this respect, they beg at the same time to express their regret that the accommodation necessary for carrying on the fishing successfully has not kept pace with the increase in the number of boats. That the harbour is quite inadequate to accommodate the trade as now increased, especially in the event of a heavy fishing, or in bad weather; so much is this the case, that, were there an average of 20 to 30 crans in one day, many crews would be unable, from the want of quay-room, to discharge their fish in time to go to sea next night, besides losing the official brand to the fish, which must be the case if they are not cured within 24 hours after being taken.

Such a state of things the memorialists are convinced must prevent any further increase of the trade, however desirable for the good of the town such increase may be.

Under these circumstances the memorialists conceive it is imperatively necessary to provide additional accommodation for the growing trade of the port, which they believe can only be efficiently done by making a new harbour at the back of the north pier, where there is a natural basin of sufficient extent to accommodate 200 boats, having a greater depth of water than the present harbour, and where a great extent of curing-ground can be got, on which the fish could be cured without the expense and deterioration caused by carting them in a green state as is done at present. This of itself, the memorialists are convinced, would be a boon of the greatest importance to the trade of the port, seeing that it is chiefly because of their superiority in this matter that Wick and Peterhead have attained to their present state of prosperity as fishing-stations.

May it therefore please your Honourable Board to take the premises into your serious consideration, and the memorialists shall ever pray.

ALEX. BRUCE, *Fishcurer,*
and 67 others.

Fraserburgh, October 30, 1845.

No. 224.

No. 224.
Statement of cost of improvements in the Harbour.

Statement of Period and Cost of Erection of the several Piers and Quays, and of Excavations in the Harbour.

October 31, 1846.

	£.	s.	d.
North pier, designed by Rennie, erected about 1808, cost	11,332	17	3
South quay, about 1818	6,611	4	6
Middle pier or jetty, 1830	5,654	18	3
Laid out on excavations during the last six years	2,103	4	7½
	£25,702	4	7½

H. C. G. BROWN, *Clerk to Harbour Commissioners.*

APPENDIX C.

FRASERBURGH.

No. 225.
Chalmers, on the erection of the Piers.

No. 225.

Memoranda by LEWIS CHALMERS, Esq., *relative to Building the Piers at Fraserburgh.*

Fraserburgh, May 1, 1847.

I FIND that Mr. Rennie had given a design of a south pier, but it was very different from the one given by Mr. Stevenson; it extended several hundred feet further south-eastward, and laid the mouth of the harbour quite open to the sea, running from N.E. Mr. Rennie made no report on his plan, so far as I can ascertain.

The old north pier, built in 1745, was a dry stone pier, and nearly on the same site as the present north pier, which was built by Mr. Stewart of Plymouth, between the years 1808 and 1811; and the materials of the said old pier were used in the hearting of the present north pier. Mr. Telford only inspected the present north pier, when built by Mr. Stewart, about 1811, I think; and I suppose, gave a report to the Commissioners of Highland Roads and Bridges, Edinburgh, who advanced part of the expense of building it. Mr. Telford had nothing to do with the building.

Mr. Walker and Mr. Gibb met at Fraserburgh, and they both agreed that Mr. Wolker's plan should be adopted, and that Fraserburgh, from its situation, was fitted for being a harbour of refuge, being at the entrance of the Moray Frith, and eastern extremity of the Caledonian Canal; also at the point vessels going north or south, whether intending to enter the canal or otherwise, have to change their course, and might have shelter at all times in the Fraserburgh harbour, in gales of wind, and often prevent their running to Cromarty, on the Frith of Forth; Montrose, the best harbour between Fraserburgh and the Frith, being attended with difficulty as a harbour of refuge.

I have had communication with many of the seafaring people, particularly with the coast guard officers, who, from their constant observations, are well-qualified to judge of the importance of a refuge harbour at Fraserburgh, and they seem all of one mind as to Fraserburgh being the most proper port as a harbour of refuge.

LEWIS CHALMERS.

No. 226.
Income and Expenditure.

No. 226.

Return of Income and Expenditure for the Years 1841-2-3.

INCOME.				EXPENDITURE.			
Heads of Income.	1841	1842	1843	Heads of Expenditure.	1841	1842	1843
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Tonnage dues .	425 17 10	475 10 2	442 8 11½	Salaries . . .	190 17 0	250 17 0	270 17 0
Duties on goods .	1206 7 3	1291 8 9	1419 11 10	Repairs and works	410 8 10½	1242 11 3½	1075 9 9
Ballast sold to shipping . .	12 6 3	15 10 9	13 13 6	Patent slip . .	..	708 15 1	..
Rents . . .	12 3 2	15 1 0	19 17 0	Paid to creditors of harbour .	307 2 0	..	..
Interest . . .	41 10 0	62 14 0	27 9 1	Interest on money borrowed . .	121 6 6	105 19 10	105 19 10
Total. £	1698 4 6	1860 4 8	1923 0 4½	Total . . £	1029 14 3½	2308 3 2½	1452 6 7

The dues are levied under Act 2 & 3 Vict., c. 66.
Debt due on the 1st of January, 1846, 12,496*l*.

ALEX. BEGG, *Clerk to Harbour Commissioners.*

PITTULIE.

No. 227.
Income and Expenditure.

PITTULIE.

No. 227.

Return to Address of the House of Commons of July 29, 1844.

Income.	1841	1842	1843	Expenditure.	1841	1842	1843
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Tonnage dues . .	..	1 1 0	0 10 0	Repairs, lamps, &c.	6 12 0		
Dues on goods . .	..	3 19 10	2 10 0	Collecting dues .	..	0 4 7	1 0 0
				Incidental expenses, &c.	2 17 10	11 19 1	
	..	5 0 10	3 0 0		9 9 10	12 3 8	1 0 0

The dues are levied by order of the Proprietor, without any Act of Parliament.

Nov. 16, 1844.

ROBERT SUTHERLAND, *Clerk.*

ROSEHEARTY.

No. 228.
Return to Address of the House of Commons of 29th July, 1844.

ROSEHEARTY.

No. 228.

Return to Address of the House of Commons of July 29, 1844.

SIR,

November 7, 1844.

THE town of Rosehearty is authorised by its charter, granted by Charles II., and signed by Alexander Lord Pitsligo, in the year 1682, to collect the shore-dues, and expend the same, by and with permission of the superior of the estate, in building and repairing the harbour.

Its trade consists chiefly in herring-fishing, which is various according to the success of the season: the other exports are agricultural produce, and the imports lime, coals, wood, &c.

From Whitsuntide 1841 to 1842 the harbour-dues were let to a tenant at 65*l*.

Appendix C.

Rosehearty.

No. 228.
Return to Address of the House of Commons of 29th July, 1844.

From Whitsuntide 1842 to 1843.

The revenue from herrings was	£50
From agricultural produce	12
Imports	8
	£70

From Whitsuntide 1843 to 1844.

From herrings	£55
Agricultural produce	13
Imports	7
	£75

Which sums have been expended in paying off part of the debt contracted in building a pier, and part in paying interest on the remaining debt, with other necessary expenses.

Extracted from the town and harbour books, by order of the Town Council.

The Honourable H. Manners Sutton, David Rae, *Clerk.*
&c. &c. &c.

GARDENSTONE.

No. 229.

Return to Address of the House of Commons of July 29, 1844.

Gardenstone

No. 229.
Income and Expenditure.

Income.	1841	1842	1843	Expenditure.	1841	1842	1843
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Shore dues let for .	87 0 0	81 0 0	83 0 0	Repairs and works .	2 18 1	13 13 7½	6 11 11½

The harbour of Gardenstone, it is said, was built about the year 1740 by Alexander Garden, Esq., then the proprietor of the estate of Troup. It appears that a table of those dues to be levied at the harbour was then drawn out, and it has been the custom from that period to let them from year to year.

W. Wernham, *Factor.*

MACDUFF.

No. 230.

Return to Address of the House of Commons of July 29, 1844.

Macduff.

No. 230.
Income and Expenditure.

Income.	1841	1842	1843	Expenditure.	1841	1842	1843
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Shore dues . . .	244 0 0	231 0 0	244 0 0	Repairs and works .	141 13 2¾	24 11 9	12 1 8

Under authority of the Trustees of the late James Earl of Fife, who let the dues by public roup.

Edward Mortimer, *Factor for Down.*

March 27, 1845.

No. 231.

Memoranda relative to the proposed new Harbour at Macduff, by James Bremner, Esq., C.E.

December 1, 1846.

No. 231.
Bremner, on a new Harbour at Macduff.

The western portion of the present harbour of Macduff is about 420 feet in length by 120 feet average width, and contains an area of about 5500 square yards. The inner harbour is 250 feet long by 150 feet wide, with an area of 4000 yards; the outer harbour is 250 feet long by 250 average width, having an area of about 7000 yards; the whole making an extent of 16,500 yards, or 3½ acres, all dry at low-water spring tides.

To form the new harbour it is proposed to extend a breakwater pier from the elbow of the present east pier for 580 feet in a N.W. by W. direction (magnetic), with the outer portion kanting a point more to the westward, to finish with a circular head in 22 feet depth at low water, and 33 feet at high-water spring tides. The wall is to be built nearly vertical; the surface of the quay to be 4 feet above the level of high-water spring tides, and the height of the parapet to be 16 feet. This breakwater will effectually cover the sheltered space from all northerly and easterly gales.

Secondly, it is proposed to extend a pier in a north-east direction 750 feet, towards the outer end of the northern breakwater, leaving an opening between of 130 feet wide; from the extremity of this western pier a kant of 250 feet appears by the plan to be projected at right angles. A second jetty, parallel to the western pier, is proposed at a distance of 250 feet within, thus forming a sort of basin or dock, having an opening 60 feet wide. The whole low-water space enclosed by these projected piers will be about 7 acres, having an average depth of 14 feet at low water, and 24 feet at high-water spring tides.

The width of the base of the piers is to be 50 feet, and 27 feet the width at the surface of roadway.

Thus the new harbour, when complete, will afford protection to the mariners at all times of tide in northerly or easterly gales, that is to say, at the times it is most required on this part of the coast, which has no low-water harbour from Cromarty to the Tay, a distance of 200 miles.

J. Bremner.

No. 232.

Admiralty, March 18, 1847.

No. 232.
Admiralty Report on the Harbour.

The Lords Commissioners of the Admiralty assent to this project, but recommend that the northern arm of the harbour should be first constructed, as a test of the mode of construction proposed, and as most essential to the security of the harbour.

H. G. War

APPENDIX C.

BANFF.

No. 233.
Return to Order of the House of Commons of 9th August, 1844.

BANFF.

No. 233.

Return to Order of the House of Commons of August 9, 1844.

THE Act of Parliament under which the said trustees have acted, and now act, is intituled "An Act for regulating the Municipal Government and Expenses of the Royal Burgh of Banff, North Britain; for establishing an effective Police within the same; and also for maintaining, improving, and regulating the Harbour of the said Royal Burgh;" which Act received the royal assent on the 23rd of July, 1840.

JAMES SMITH,
Clerk to Banff Harbour Trust.

No. 234.
Memorial concerning damage occasioned by Storm, and Telford's Report, &c.

No. 234.

Memorial from Banff concerning Damage occasioned by a Storm in October last; together with Correspondence on the subject of such Memorial.

Unto the Honourable the Commissioners for Highland Roads, Bridges, and Harbours in Scotland.—

The REPRESENTATION and PETITION of the Provost, Magistrates, and Town Council of the Burgh of Banff,—

MOST HUMBLY SHEWETH,

THAT for a long time past the improvement and enlargement of the Harbour of Banff have been considered an object not only of the first importance to the trade and prosperity of the town and populous country around, but also of considerable national importance, as affording refuge to vessels when overtaken by the violent hurricanes with which the shores of the Moray Frith and north-east coast of Scotland are often visited, and along which, for greatly more than 100 miles, there is no harbour at present where a vessel of any considerable burden can find shelter or safety.

That the progressive increase of shipping in the various ports on this coast, the numerous vessels continually passing along it from the Baltic and ports in the German Ocean, with the trade of the west coast of Scotland and England, and also of Ireland, and the still nearer approach of these valuable ships and cargoes when the Caledonian Canal shall be opened, impressed on the inhabitants of Banff the great importance of the object, and excited their most anxious desire for its accomplishment.

That in a head court of the burgh, the whole inhabitants, therein assembled for the special purpose of taking the matter into consideration, unanimously resolved to raise and contribute the sum of 7000*l.* towards the improvement of the harbour, and authorized your Petitioners to make application to your Honours for aid and assistance to the like amount, which it was considered might be sufficient to complete the work.

That your Petitioners did accordingly make such application to your Honours, when you were pleased to first direct Thomas Telford, Esq., civil engineer, to examine and report on Banff Harbour, and the utility and advantage to the public of the proposed improvements.

That the report of that eminent engineer having been extremely favourable, and confirming the representation made by your Petitioners, your Honours were afterwards pleased to grant an aid of 6973*l.* 10*s.* sterling, being a moiety of the expense of the work as estimated by him.

That in order that the work might not be delayed, your Petitioners became the contractors for the execution of it, agreeable to Mr. Telford's plan and specifications, and at the sum estimated by him of 13,957*l.*; and a regular contract was accordingly entered into betwixt James Hope, Esq., on the part of your Honours, and your Petitioners, in the month of July 1818.

That the execution of the work was therefore immediately commenced, and every possible exertion used in forwarding it, and the progress made, as well as the manner in which the work was executed, both received the most unqualified approbation of Mr. Telford, on his inspection in the beginning of September last. At that time there was every prospect that this great and useful work would have speedily been brought to a fortunate conclusion. The breakwater of this harbour being an operation as much exposed, perhaps, as any public work now in progress in Britain, every possible precaution had been taken to guard against the disasters and misfortunes which all such operations are liable to meet with; but unfortunately, at an unusual early period of the season, on the 21st and 22nd days of October last, this coast was visited by a hurricane more awful and destructive than anything of the kind recollected by the oldest inhabitants; the consequences of it were in general very distressing; different public works in progress suffered severely; piers which had resisted the seas and storms of more than a century were levelled down; and immense quantities of herrings, fishing materials, and other property, in situations where, at no period for ages before they would have been in danger, were swept into the sea and totally destroyed; the breakwater at Banff harbour was at this period in a half-finished state, and therefore, as was to be expected, the damage done to it by this hurricane was very great.

That immediately after this misfortune the pier was inspected by Mr. Gibb, the local engineer, who made a report of its state to Mr. Telford; the latter gentleman afterwards directed the former to make a more full and detailed report, accompanied by a plan, showing the state of the work as it stood previous to the foresaid storm, and also the effect which that storm had made upon it.

That entertaining, as your Petitioners do, the highest respect for Mr. Telford's professional abilities, they think, had the breakwater been finished, it might have withstood the effects of all ordinary storms; but they believe the most experienced engineers are ready to admit, that in a situation so extremely exposed as Banff harbour, no calculation can determine, with certainty, the weight and force of the sea during so tremendous a hurricane as that of the 22nd of October. Engineers therefore consider reverses of the nature of what has happened here as being rather in their favour, by proving to them, from experience, the utmost violence to be looked for.

That to insure, therefore, the stability of this fabric, in a situation so extremely exposed, against the

APPENDIX C.

BANFF.

No. 234.
Memorial concerning damage occasioned by Storm, and Telford's Report, &c.

effects of storms, even of so rare occurrence, Mr. Gibb accompanied his report to Mr. Telford by a recommendation that the outer end, which had been injured and greatly damaged, of the pier of Banff harbour, should be reconstructed of increased dimensions; and after the most mature consideration and personally consulting with Mr. Gibb on the subject, the suggestion of increasing the dimensions of the pier has received the entire approbation of Mr. Telford.

That the Petitioners, so far as they are able to judge, fully coincide in opinion with these engineers; but the alteration from the plan as contracted for, and increasing the dimensions of the pier in the manner now proposed, will be attended with a very considerable additional expense, perhaps not less than 2000*l.* sterling.

That your Petitioners and the community of Banff are still most anxious to make every exertion in their power to finish this great work in a manner so as to insure its stability; but the undertaking was originally great for their means; the burgh, the revenue of which is very limited, having within these few years expended large sums in the erection of a new church, a new jail, an academy, and turnpike-roads, and other public works; and in such circumstances the Petitioners feel themselves obliged, though with much reluctance, to make application to your Honours for a further aid of a moiety of the additional expense which will be occasioned by the increased dimensions of the pier, which are now considered necessary to insure its stability.

Confident that Mr. Telford will afford your Honours most particular and correct information of the present state of this harbour, and of the great injury occasioned by the foresaid storm, your Petitioners conceive any observations on their part superfluous, after the subject has undergone the consideration of that able and distinguished engineer.

GEO. G. ROAINSON, *Provost.*

Report by THOS. TELFORD, Esq., *on the damage to the Works at Peterhead and Banff Harbours, and Estimates for restoration.*

London, February 21, 1820.

I HAVE examined the Memorials from the magistrates of Peterhead and Banff, who are also the contractors for the new works at the respective harbours; and having also had communications with the resident engineer, Mr. Gibb, I am satisfied of the truth of the representations.

On my inspection, in the latter end of last August, I found that great progress had been made at both places, and that proper care had been bestowed on the works then performed. But the storm mentioned in the memorials, which happened on the 21st, 22nd, and 23rd of October, so unusually violent (even on that exposed coast) as to reach and destroy works which had stood for ages, having overtaken the Peterhead and Banff Works in an unfinished state, has very considerably injured them, so as to create an expense beyond what was originally contemplated.

This violent attack, while the works were in hand, has, however, proved what precautions are necessary against future tempests; and in this view the additional expense now required will be well bestowed.

After examining the modes of restoration and the additions proposed by Mr. Gibb, I consider them judicious, and the estimated expense reasonable; viz.—

	Cost.	Moiety.
For Peterhead Harbour . . .	£3,384	£1,692
For Banff Harbour . . .	2,000	1,000
Expense of inspection and management, say	616	308
	£6,000	£3,000

To John Rickman, Esq. THOS. TELFORN.

MY LORDS AND GENTLEMEN, *Treasury Chambers, April* 14, 1820.

IN answer to your Secretary's letter of the 10th ult. I am commanded by the Lords Commissioners of His Majesty's Treasury to acquaint you, that they do not, under all the circumstances, feel that they should be justified in recommending to Parliament to make any grant of money for the completion of the piers at Peterhead and Banff.

I am, &c.,
GEO. HARRISON.

To the Commissioners of Highland Roads and Bridges.

No. 235.

Report of J. BREMNER, Esq., C. E., *on the best means of repairing the Breakwater.*

No. 235.
Bremner, on repairing the Breakwater.

GENTLEMEN, *Banff, April* 11, 1837.

I HAVE this day made several tours round the back of the breakwater, at low water, as low down as the tide would permit, and am sorry to say that I do not by any means consider it safe in the present state it is in. One stone has been forced out by the action of the sea this last winter, and since I inspected it last fall I find many parts of it look much worse than it was at that time. As this appears to me of the utmost importance to your good town and neighbourhood, it deserves your serious and immediate attention, as it is evident, should it give way, it will be almost an irrecoverable loss, as it would completely prevent any intercourse by shipping to your port, which would be a serious calamity.

I would therefore again propose that some old chain-cables should be purchased, and bolted round your quay-head, to commence at the inner extremity of the quay-head, and securely bolted with $\frac{1}{8}$-inch iron, for 150 feet at least, along the outside, as near low-water spring-tides as possible; taking care to have a strong purchase to stretch the said chain during the time it will be bolting. From six to eight chains should be bolted down across this one, of smaller dimensions, from 30 to 40 feet

No. 235.
Bremner, on repairing the Breakwater.

long, at different places where they will be most useful. In addition to this I would recommend that a large mass of heavy materials may be hove in behind the outer foundation, which may be drove with carts and loaded on the lighter, and hove over in the places most in want of such materials.

I am, &c.,
JAMES BREMNER.

The Banff Harbour Trustees.

No. 236.

Report of J. BREMNER, Esq., C.E., *on the present state of the Harbour.*

No. 236.
Bremner, on the state of the Harbour.

GENTLEMEN,

Harbour Place, Wick, April 19, 1845.

I HAVE to acknowledge receipt of your chamberlain Mr. Smith's letter of the 15th inst., requesting me to communicate my opinion on the defects and capabilities of improvement of the harbour of Banff, preparatory to your making a return on that subject to be laid before the House of Commons, pursuant to a resolution of the House in August last.

In answer I beg leave to observe that, where harbour-walls are built in a line parallel with the course of the waves to the shore, similar to yours, it is impossible to give them, in extreme exposure to the sea, a sufficient power of resistance to its violence. Harbour-walls should be constructed so as to oppose and avert the sea within 25 degrees at least of the building, otherwise it will shock the whole line at once; but, by observing this precaution, the sea will strike on the outer breakwater-head, and, being resisted, it will run along the back of the wall and exhaust its power, carrying with it the moveable sand and other alluvium that become great nuisances in harbours.

In 1837, when I was called to inspect the harbour of Banff, I observed and explained the radical defect in the plan and construction of it, which had occasioned great expense and trouble in temporary repairs. The breakwater was unfortunately lined off exactly parallel to the sea, giving a slope of three horizontal to one perpendicular. The foundation had thus no superincumbent weight to render it solid or secure; and the recoil of the sea was in constant and powerful operation in loosing and forcing out the foundation stones of the building. Notwithstanding the exertions made by the trustees to support the structure by every devisable means, particularly by fortifying it with large blocks of stone, of from two to three tons weight each, in each succeeding year, I found that the harbour had sustained damage to a very great extent, and was then threatened with total destruction in its peculiar exposure to storms and heavy seas from north-west to south-east. At this crisis, and to prevent otherwise inevitable ruin of the whole building, floating casks of immense size with leweses, made under my directions, were then applied with gratifying effect and success in raising and conveying from considerable distances stones of the enormous weight of from 15 to 40 tons each, by judicious disposal of which along the outer edge of the breakwater, the building has since been preserved from total destruction.

The bottom of the bay, and in parts adjacent to the harbour of Banff, consisting of sand, the basin was rendered extremely subject to accumulations of sand admitted at the two entrances shown on the plan of the old and new breakwaters; and from the great width of the other entrance, such a collection was formed within the new harbour about two years ago, to the depth of three feet. Having been consulted by you on the means of preventing similar inconvenience, I advised that the entrance to the new harbour should be contracted and boomgates erected, which was accordingly done. On adopting that method the new harbour was effectually cleared of the incumbent sand, and no accumulation has occurred since.

The old harbour, however, continues subject and peculiarly exposed to the influx and accumulation of sand from the long flow of shoal-water, which, when agitated by wind, carries great quantities of sand into the basin. The best, if not the only, mode of rendering the harbours of Banff beneficial for the purposes of shipping and trade would be to construct another breakwater 150 feet without the present one, into a greater depth, where the sands and other alluvial substances are less agitable, and for certain prevention against the accumulation of sand to give to the breakwater a curve of sufficient length in projection beyond the other breakwater, terminating the latter in an acute angle, faced sharp within, at the entry of the harbour; by which means the sea, in striking the angle after falling off the projection or outer head, would be effectually resisted and driven *outward*, carrying with it the sand to the back of the harbour.

By effecting these operations your harbour would afford shelter and additional accommodation to shipping at all times of the tides, and would be exempted from annoyance of sand or other silt. The great benefit your harbour, so improved, would confer must be evident on consideration that there is no other harbour with sufficient depth of water between Aberdeen and Cromarty capable of receiving vessels when embayed on your coast with northerly winds.

I have, &c.,
JAMES BREMNER.

To the Trustees of the Harbour of Banff.

No. 237.

Report of JAMES ABERNETHY, Esq., C. E., *on the best means of Improving the Harbour, and Estimate.*

No. 237.
Abernethy, on improving the Harbour, and Estimate.

GENTLEMEN,

Aberdeen, May 9, 1845.

IN accordance with the letter addressed to me by Mr. Smith, your clerk, of date April 15, requesting me to inspect and report as to the best mode of improving your harbour, I visited Banff on the 18th and 19th of April, and, having well and carefully weighed the matter, I beg to report as follows:—

The evils which attend your present harbour are—

1. Its exposure to the action of the sea in north-easterly gales.
2. The accumulation of sand within the harbour, more particularly in the outer basin.

These evils are obvious, and may be remedied more or less effectually, according to the extent of the means employed; I shall therefore report on the matter under the three following heads:—

1. The improving of the harbour, so as to remedy the existing evils, and fit it for the admission of steam-vessels.

APPENDIX C.

BANFF.

No. 237.
Abernethy, on improving the Harbour, and Estimate.

2. A modification of this plan, so as to fit it for the safe admission and protection of sailing-vessels.

3. The improving of a portion of the harbour, such as the outer basin.

With respect to the first evil, the action of the sea, it appears to me that the only way of sheltering the harbour from easterly storms is, by the extension of the present north pier in the direction shown on the accompanying plan. By this extension the harbour entrance would be completely sheltered from all easterly seas, and vessels will be in safety even at the present harbour entrance; the great body of the sea impinging on the proposed extension will be thrown off to the southward, and any portion of it rolling round the point of the north extension will be caught and thrown off by the extension shown of the present south pier.

The second evil, viz. the accumulation of sand within the harbour, is caused, in a great measure, by the near proximity of the river-mouth, the deposit brought down by the river being thrown directly into the harbour entrance by the tide, the action of the sea in easterly gales, and the want of any opposing force. The only effectual mode of getting rid of this is to divert the river into what was, I believe, its ancient channel, as shown on the accompanying sketch, by first cutting a channel through the beach, and then forming a bulwark across the present channel of the river, which may be done by driving two rows of fir-piles and backing them up with fragments of rock: this would preserve the embouchure permanently in the direction laid down.

The present harbour being intersected by jetties, rendering it perfectly unfit for the admission of steam-vessels, I would recommend their total removal; the spare material could be used up in the proposed extension of the piers and in widening the road leading to the town and forming there a quay—an improvement, in my opinion, of much importance.

In addition to the removal of the jetties, I would recommend the removal of "Bobby Leil" rock, and the general deepening of the harbour to a depth of 14 feet high-water spring tides, as shown on the tranverse sections.

By carrying out these various operations I have no hesitation in affirming that the evils which at present attend the harbour would be effectually remedied and the harbour rendered fit for the safe admission of the general class of coasting steam-vessels.

I estimate the expense of executing this plan at 8000*l*.

With respect to the general accommodation of sailing-vessels, I would recommend the same extension of the north and south piers, the removing of the "Bobby Leil" rock, the deepening of the outer basin to 14 feet spring-tides, and the shortening of the inner jetty at the booms, as shown by the faint red line.

As in the former case, I would recommend the diversion of the river.

The carrying out of this plan I estimate at 7200*l*.

Supposing it should not be considered judicious at present to carry out the extension of the piers, and the diversion of the river, then, for the better preservation of vessels within the harbour, I would recommend that the entrance by the "Bobby Leil" rock should be built up altogether, and an entrance made into the present inner basin, as shown by the faint red lines.

The booms, which I consider the best plan that could be devised under existing circumstances, to be retained; and I may here remark, that I would not advise them to be put down nearer the bottom than 3 or 4 feet, as it is the under current that the partial removal of the sand is attributable.

The basin should be deepened throughout to the extent of low-water mark spring-tides.

I estimate the expense of these operations at 1500*l*.

I am, &c.,
JAMES ABERNETHY.

To the Banff Harbour Trustees.

No. 238.

No. 238.
Income and Expenditure.

Return of Income and Expenditure for the Years 1841–2–3.

INCOME.									
Heads of Income.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Shore dues on goods imported and exported	754	2	10	702	0	0	661	0	0
Berthing dues . .	16	9	0	17	12	0	17	1	8
Pier head light dues .	7	7	6	8	0	6	7	6	0
Crane dues . . .	9	16	7	6	9	5	5	10	0
Received for use of casks	1	6	0	0	2	0		..	
Dues on goods lodged in bond dwarehouse		..		3	7	3	1	15	9
Plonkage	2	14	6	1	17	6	1	15	6
Ballast sold, and use of lighter . . .	8	4	0	5	4	0	9	13	6
Incidents		..		0	5	0		..	
Interest	0	11	9	0	4	0	1	14	3
Total . . £.	800	12	2	745	1	8	705	16	8

EXPENDITURE.									
Heads of Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Salaries	28	0	0	28	0	0	28	0	0
Repairs and works .	22	16	11	30	8	11½	19	6	11½
Clearing harbour .	63	16	10	77	4	5	44	15	0
Gas for harbour lights. . . .	9	14	0	9	14	0	9	14	0
Rent of premises and expenses .	10	0	0	15	6	6	14	6	0
Collecting shore dues	79	0	3		..			..	
Miscellaneous . .	25	5	2	21	0	1	17	10	5
Income tax . .		..			..		11	13	5
Interest of debt .	346	2	6	403	13	10	294	17	11
Total . . £.	584	17	8	585	7	9½	440	3	8½

The dues are levied under Act 3 and 4 Vict. (Royal Assent, July, 1840.)

JAMES SMITH.

Debt due on the 1st of January, 1846, 8201*l*.

APPENDIX C.

WHITEHILLS.

No. 239.
Income and Expenditure.

WHITEHILLS.

No. 239.

Return to Address of the House of Commons of July 29, 1844.

Income.	1842	1843	1844	Expenditure.	1842	1843	1844
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£ s. d.	£. s. d.
Total revenue.	32 4 9½	34 9 11½	20 12 11½	Repairs	2 18 0	..	11 10 0
				Superintendence .	6 8 9	6 18 0	4 2 7
					9 6 9	6 18 0	15 12 7

The Earl of Seafield, sole Proprietor.

No SIGNATURE.

PORTSOY.

No. 240.
Income and Expenditure.

PORTSOY.

No. 240.

Return to Address of the House of Commons of July 29, 1844.

Income.	1842	1843	1844	Expenditure.	1842	1843	1844
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Total Revenue . .	236 0 0	232 0 0	286 13 4	Repairs	20 15 2	535 10 4	341 0 11
				Superintendence. .	3 3 0	6 3 0	15 18 0
				Total	23 18 2	541 13 4	356 18 11

The dues are levied under the authority of the Earl of Seafield, who is the sole proprietor of the harbour.

No SIGNATURE.

BLACKPOTS.

No. 241.
Income and Expenditure.

BLACKPOTS.

No. 241.

Return to Address of the House of Commons of July 29, 1844.

BLACKPOTS.

	Revenue.	Expenditure.
For the year to 1st November, 1842.	£3 10 0	Nill.
For do. to do. 1843.	2 14 0	,,
For do. to do. 1844.	3 0 0	,,

The dues are levied under the authority of the Earl of Seafield, sole proprietor of the harbour and adjoining lands.

No SIGNATURE.

CULLEN.

No. 242.
Income and Expenditure.

CULLEN.

No. 242.

Return to Address of the House of Commons of July 29, 1844.

Income.	1842	1843	1844	Expenditure.	1842	1843	1844
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Shore Dues . . .	53 0 0	56 15 0	61 11 8	Repairs and Works .	. .	5 7 9	14 13 5
				Clearing out Sand .	4 15 0	30 0 3	42 7 11
				Harbour Lights . .	. .	. .	4 16 2
				Mooring Posts . .	. .	. .	3 16 0
	53 0 0	56 15 0	61 11 8		4 15 0	35 8 0	65 15 6

The dues are levied under the authority of the Magistrates of the Royal Burgh.

SEAFIELD.

PORT GORDON.

No. 243.
Income and Expenditure.

PORT GORDON.

No. 243.

Return to Address of the House of Commons of July 29, 1844.

Income.	1842	1843	1844	Expenditure.	1842	1843	1844
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Shore and Harbour Dues	132 0 0	135 0 0	126 10 0	Repairs and Works .	76 0 4	232 18 6	173 16 1

The property of the Duke of Richmond; the harbour was built by the late Duke of Gordon, 40 years since.

ALEX. MARQUIS.

Nov. 6, 1844.

GARMOUTH.

GARMOUTH.

No. 244.

Return to Address of the House of Commons of July 29, 1844.

No. 244. Return to Address of the House of Commons of 29th July, 1844.

December 17, 1844.

SIR,

IN reply to your communication of the 13th of November, relative to the harbour of Garmouth (or Kingston), I beg to state that it does not come under the denomination of a harbour, but merely a creek, or anchorage, in which no dues are exigible beyond 1*d.* per ton register, which is charged on such vessels as make use of some moorings placed in the water and on the land by his Grace the Duke of Richmond, who is the proprietor, and from whom I hold it at the rent of 12*l.* 10*s.* per annum. Should any further information be required I shall be most happy to furnish it in so far as lies in my power.

I am, &c.,
W. HOGARTH.

The Hon. H. Manners Sutton,
&c. &c.

LOSSIEMOUTH.

LOSSIEMOUTH.

No. 245.

Return to Order of the House of Commons of August 9, 1844.

No. 245. Return to Order of the House of Commons of 9th Aug. 1844.

May 2, 1845.

SIR,

IN compliance with the requisition to the Directors of the Stotfield and Lossiemouth Harbour Company of date the 1st of February last, I beg leave to transmit to you, by order of the said Directors, a copy of the plan of the said harbour; and to explain that the extension of the North Quay and of the Inner Basin, shaded in pink on the plan, have now been contracted for at an outlay of £4190 sterling, and that the transmission of the plan has been delayed until the contract should have been entered into.

The title of the Act of Parliament for this harbour is 4th and 5th William IV. chapter 86.

I have, &c.
PATRICK DUFF, Clerk to the Directors.

The Honourable H. M. Sutton,
Under Secretary of State, Whitehall, London.

No. 246.

Letter from MR. JOHN ALLAN, *a Merchant, on the Excessive Rate of Harbour Dues.*

No. 246. Allan, on the excessive Rate of Harbour Dues.

October 7, 1846.

I HAVE looked over the proposed Harbour Conservancy Bill, which I now return.

It appears to me that the Commission did not contemplate any interference with existing harbour dues, and although there may be in the Bill some slight movement in that direction, I do not think it so full and decided as it might and ought to be.

I am firmly of opinion that the Commissioners should be strongly urged to have a clause introduced into the Bill on this particular point. The public have in many cases been too supine, while corporations and others were obtaining Acts of Parliament for harbours; and unless protection be afforded by some such Bill as the one now proposed, the business and property of traders and others will remain at the mercy of greedy and interested harbour proprietors.

As a case in point, I need only mention that of Lossiemouth, and it is one which cries loudly for interference. Some ten or twelve years ago a plan of a harbour proposed to be built near that place was deposited with the proper authorities, and an Act of Parliament, proceeding upon and referring entirely to this particular plan, was in due time obtained. The proposed works were extensive, and the outlay large, in consequence of which the company or corporation were empowered by their Bill to levy harbour dues on imports, exports, and shipping, as high and, it is believed generally, higher than are paid in any other port in Scotland.

No sooner was the Act obtained than the proprietors, finding that the proposed harbour was likely to cost too much money, proceeded to erect a harbour upon a plan totally different from the one for which the Act of Parliament was obtained, costing less money and affording less accommodation. For a year or two the extreme dues authorised by the Act were commuted according to a scale made up by the directors, but these gentlemen very soon affected to find out that anything less than the highest rates was not legally exigible, and the public have therefore for many years past been paying at Lossiemouth harbour dues at least as high (as I have said) as the largest and most expensive port in Scotland, and higher by from 100 to 300 per cent. than are exacted at any other harbour in this quarter.

It appears to me that this is very hard, if it is not indeed illegal. I know it is much against the interest of the trader and of the public generally, and I am inclined to think that it is almost equally against the interests of the harbour and its proprietors.

JOHN ALLAN.

No. 247.

Lieut. JOHN TOD, R.N., *Lloyd's Agent, on the Proceedings of the Harbour Board.*

No. 247. Tod, on the Proceedings of the Harbour Board.

November 28, 1846.

I DULY received your letter of the 16th September, with a copy of the proposed Bill, together with the First and Second Reports of the Commissioners.

I observe what the Commissioners in their Second Report say about the money that is misapplied by irresponsible directors; were I to enter on that subject I could say a great deal, but shall merely confine my observations to the following remarks, namely, the apparent disregard, of the 21 landsmen, who are the directors of this harbour, to the lives of British seamen and the property of British

APPENDIX C.

LOSSIEMOUTH.

No. 247.
Tod, on the Proceedings of the Harbour Board.

merchants. First, when the harbour was open to the public in 1839, an old ship captain was, at the recommendation of several of the principal shareholders, appointed harbour-master, pilot-master, &c, at a salary of only 10*l.* a-year. The trade and revenue increased daily, and not a shadow of complaint was made by any party; but at the end of the first year, the worthy tradesmen of Elgin, who were harbour directors at the time, complained of this high salary of 10*l.* a-year; they then dismissed this seaman, who was a shareholder to five times the amount of some of the directors, and, incredible as it may appear, they appointed a landsman and publican, not a shareholder, from the very interior of the country, to be harbour-master, berthing-master, and, to complete the farce, pilot-master; the consequence was, that first one and then another of the Leith traders were run on the rocks and damaged. When the owners, seeing no safety or protection for their fine vessels at this port, withdrew them altogether, so that now the whole of our London, Leith, and Aberdeen trade is monopolised by the Creek at Burghead, which is far more distant from Elgin, and not half so commodious as this port is.

At one time we wanted a few pilots licensed, and a Committee of the Directors were appointed to meet at Lossiemouth for that purpose; and although our Harbour Act is most explicit on that head, namely, that no person shall be licensed or appointed pilot until due inquiry be made as to his qualifications for such appointment; mark how this point was settled:—The Committee appointed for the purpose of making such inquiries into the men's qualifications in seamanship, &c., consisted of one shoemaker by trade, of Elgin, one house-carpenter, one watchmaker, one farmer, and their clerk (a writer). These tradesmen, all good respectable men in their way, and having each a trifle invested in the harbour, came to Lossiemouth; but in place of coming to the Harbour-office and taking the advice and assistance of myself and other old seamen, the party assembled at a public house, and, without consulting any person qualified to give advice, they selected a set of men who had never conducted a vessel either into or out of the harbour; and the consequence was that the very first vessel (a fine schooner) that they attempted to take into the harbour, they run her (with a fair wind) on the lee rocks, broke her keel, and put the underwriters to an expense of 155*l.*

Again, when we wanted a harbour-lighter, the house-carpenter sent a plan to a boat-builder, who built a craft in no way adapted for the purpose, which cost 55*l.*; and during the first evolution performed inside the harbour, the said box upset and drowned one man and perilled the lives of several others, and irreparably damaged herself.

I may state that the pilots above mentioned (after driving some of the old experienced pilots from the port), finding themselves unqualified for the situation, gave it up, and left the port without a pilot, which circumstance the shipmasters published in the *Elgin Courant.*

Six months ago our transporting buoy outside the harbour was washed away, and, regardless of the shipmasters' remonstrance, it is not replaced to this day; consequently vessels are frequently kept in harbour weeks at a time during easterly winds.

To the Secretary of the Tidal Harbours Commission. JOHN TON, R.N.

P.S. Surely a harbour like this, which has cost 20,000*l.*, and paying upwards of 1000*l.* rent annually, should be put under the management of some qualified person, which it is not at present, nor has it been so for two years, although the port charges are most exorbitant, and exacted to the last farthing, the dues being let by auction for two years at a time, to the highest bidder.

No. 248.
Income and Expenditure.

No. 248.

Return of Income and Expenditure for the Years 1841–2, 1842–3, 1843–4.

INCOME.										EXPENDITURE.									
Heads of Income.	1841–2			1842–3			1843–4			Heads of Expenditure.	1841–2			1842–3			1843–4		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Total harbour, anchorage, and tonnage dues, as rented .	753	0	0	852	0	0	852	0	0	Salaries, repairs of harbour and interest on loans . . .	311	8	0	258	0	0	254	0	0
										Dividends paid to shareholders . .	441	12	0	444	0	0	448	0	0
										Amount set aside for liquidating debt .	..			150	0	0	150	0	0
										Total . . £.	753	0	0	852	0	0	852	0	0

Dues levied under the authority of the Act 4 & 5 Will. IV., c. 86. Property of a joint stock company.

PATRICK DUFF, *Clerk to Directors.*

Debt due on the 1st January, 1846, 7,000*l.*

BURGHEAD.

No. 249.
Return to Order of the House of Commons of 9th Aug. 1844.

BURGHEAD.

No. 249.

Return to Order of the House of Commons of August 9, 1844.

I. Right of property.

Seven-eighths of the harbour of Burghead belong to the trustees of the late William Young, Esq., of Burghead, and one-eighth part to Messrs. John Duffus and Company, iron-founders in Aberdeen.

II. Title.

The proprietors have right to the harbour in virtue of several crown charters; among others crown charter in favour of the late William Young of Burghead, dated second June, eighteen hundred and twenty-one.

III. Plan or drawing of harbour.

A map or plan of the harbour is herewith transmitted.

No. 249. Return to Order of the House of Commons of 9th Aug., 1844.

IV. Reports of engineers.

Several engineers have examined the harbour at different times, but if any specific report was made by them it cannot now be found.

V. Complaints on defects in harbour.

No complaint was ever made so far as is known against the sufficiency of the harbour for the coasting-trade; and at a moderate outlay it might be made the best harbour on the east coast of Scotland; it is so situated and sheltered that no wind with a long fetch can bear upon it, and the steam-vessel plying between the Moray Firth and London can already enter at quarter-tide.

P. CHRISTALL, *Harbour Master.*

Burghead, February 21, 1845.

No. 250.

Extract of a Letter from the Town Council, Burghead.

No. 250. Grigh, on Harbour Dues.

December 9, 1846.

IN the proposed Harbour Conservancy Bill, provision should be made to lessen and regulate dues. In some cases very high dues have been sanctioned by Parliament, in consequence of parties representing that extensive works were to be constructed for the accommodation of the public, which have never been executed. It is, therefore, essential to the prosperity of commerce that power be taken to regulate dues. The copy letter herewith sent (No. 246) from one of the most extensive and intelligent merchants in this quarter, affords a striking illustration of the necessity for such a Board as is proposed, and for its having such powers as I am endeavouring to enforce. It would also have a good effect to provide for the annual publication of accounts, or at least that these should be open for inspection at the office of the Commissioners some twelve or fourteen days each year. The Act 8 and 9 Vict., c. 83, provides for the constitution of such a popular Board as I have suggested, in reference to the administration of the Poor-laws in Scotland; and the Act 2 and 3 Will. IV., c. 76, provides for the due publication of all burgh accounts in Scotland.

WM. GRIGH, *Baron Bailie.*

No. 251.

Return of the Income and Expenditure for the Years 1841–2–3.

No. 251. Income and Expenditure.

INCOME.				EXPENDITURE.			
Heads of Income.	1841	1842	1843	Heads of Expenditure.	1841	1842	1843
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Tonnage dues . .	57 4 11	55 12 8	53 14 10	Expenditure	..	..	..
Imports and exports	274 17 6	280 1 3	270 14 4				
Total . . .	332 2 5	335 13 11	324 9 2				

Dues levied by Royal Charter. The proceeds of the dues are laid out in repairs, dredging, and in payment of interest on loans.

P. CHRISTALL, *Harbour Master.*

Debt due on the 1st January, 1846, 23,369*l.*

FINDHORN.

No. 252.

Return to Order of the House of Commons of August 9, 1844.

No. 252. Return to Order of the House of Commons of 9th Aug., 1844.

Linkwood, near Elgin, February 5, 1845.

HUGH ANDREW JOHNSTONE MUNRO, the present proprietor of the port and harbour of Findhorn, and his predecessors, have acted and he now acts under authority of an Act of Parliament entitled "An Act to enable Hector Munro, Esq., to build and maintain a Harbour and Pier at the Town of Findhorn, in the County of Elgin and Forres."

There is no plan of the harbour or port of Findhorn in the possession of the said Hugh Andrew Johnstone Munro, nor does he think that any such is extant; neither are there any reports by engineers or other officers respecting said port and harbour in his possession, and there never have been any complaints made to the said Hugh Andrew Johnstone Munro of the defects of said port or harbour.

PETER BROWN,
for H. A. J. MUNRO.

No. 253.

Return of Income and Expenditure for the Years 1842–3–4.

No. 253. Income and Expenditure.

INCOME.				EXPENDITURE.			
Heads of Income.	1842	1843	1844	Heads of Expenditure.	1842	1843	1844
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Total revenue, by lease	200 0 0	200 0 0	200 0 0	Repairs of harbour .	3 1 10	..	25 0 0

Dues levied under the authority of an Act passed in 1777.

PETER BROWN, *Factor for H. A. J. Munro, Esq.*

NAIRN.

No. 254.
Return to Address of the House of Commons of the 29th July, 1844.

No. 254.

Return to Address of the House of Commons of July 29, 1844.

SIR,

Nairn, April 2, 1845.

As directed by the magistrates and town council, I beg to report, in obedience to your order of 15th November, proceeding on the resolution of the House of Commons dated 29th July, 1844, that the receipts and expenditure of the harbour of Nairn for the years 1841, 1842, and 1843, have been as follows, viz.:—

	Received.			Expended.		
	£.	s.	d.	£.	s.	d.
1841	83	0	0	35	9	2
1842	90	0	0	23	13	0
1843	101	0	0	120	4	1

The shore-dues are set for an annual rent, and there can therefore be no division into heads of income.

It is impossible to state with certainty the authority or authorities under which they are levied, as the original charters have by some accident been lost or destroyed; but reference is made to the parliamentary ratifications 3rd April, 1661 and 1597, and to the confirmation and infeftment 16th October 1589, and "former infeftments of erection" therein mentioned.

There has been no classification of the expenditure, the items being all entered in the burgh accounts under the general head "Harbour Expenses."

I have, &c.,

ADAM DAVIDSON, *Town Clerk.*

The Hon. H. Manners Sutton,
&c. &c.

No. 255.
Gibb, on improving the Harbour, and Estimate.

No. 255.

Report of JOHN GIBB, Esq., C.E., *on the best means of improving the Harbour, with Estimate.*

SIR,

April 25, 1816.

IN compliance with your letter of the 12th ulto., requesting me to survey the shore of Nairn, I reached Nairn on the 25th, and, having generally reviewed the shore and river from the shelving rocks near the pawls for two miles upwards, on the 27th I attended your Committee, and there stated in general terms what had then occurred to me, and received from your Committee written directions minutely to survey the boat-shore and river-mouth, and to give in a plan, estimate, and report of such a pier as would meet the views of the subscribers.

Having carefully surveyed the bay from the boat-shore near the herring-sheds to the bar, which is distant nearly three-quarters of a mile from the pawls at the old landing-place, on the 28th, being the first day of the moon (consequently the tides in their best state), I proceeded with the soundings, and found, within about 350 feet of high water line, opposite Black's Fen, full 11 feet water, which I concluded was the rise of the tide for that day, although it was not considered a high spring, the water uniformly deepening outwards, with excellent anchorage-ground; on going eastward the water gradually becomes of less depth; and, after passing the *Heathery Hill*, the shore spreads out into an immense flat until it reaches the estuary of the river at what is commonly called the bar. Having commenced sounding on the bar, I found there was barely 8 feet at high-water. Continuing the soundings up the proper channel of the river, I found them as follows: 8 feet, 8½ feet, 7½ feet, 9 feet, with various small banks, and the water at the old landing-place opposite the pawls 8 feet deep in the middle of the channel. Having consulted with the most experienced seamen, fishermen, and others, who have been attentive observers of the shore of Nairn, all of whom deserve the most entire credit, it is evidenced, from the actual state of the alluvial matter on the coast, that great changes have taken place in the channel of the river Nairn in its passage towards the sea, although it is impossible to give any exact detail of the successive progress of these changes, as no precise measures have been kept; it is evident, however, that the river is bending its course in a south-east direction, and the present channel, for some distance below the pawls, is nearly parallel with Brodie shore. In proportion as the promontory extends, the yearly quantity of the alluvial depositions increases, owing to the diminished slope of the stream; and the additional cultivation on the lands above has a constant tendency to send down greater quantities of alluvial matter every land-flood, which, when it reaches the flat shore and meets with a contrariety of action from the sea and tides, is immediately deposited and forms *bars*, *banks*, and shoals. As this operation in nature must continue to go on, and that in a greater proportion as the length of the channel towards the sea is increased, the possibility is that the depth of water in this channel is rather on the decrease. From this view of the matter, I beg leave to recommend, as the more safe course, to enclose a space by building a pier and *insulated* breakwater at the back shore, nearly opposite Black's Fen, conform to the plan which accompanies this report (where the vessels at present discharge their cargoes in preference to attempting the tedious navigation from the bar to the old landing-place), where the bay is deepest and best sheltered, which will be seen by the bearings of Tarbetness and Maviston sand-head, which last forms a very great protection to this part of the bay: and here the ground is perfectly clear and suitable for a roadstead. To the westward is much the same depth for a considerable distance off, and, although less expensive for a foundation, would not be suitable for a roadstead. Excellent freestone can be readily procured within less than half a mile of the proposed site of the pier.

I therefore advise that the pier should be carried rather beyond low-water mark of a stream tide, in the form and dimensions I have shown on the plans and sections, with a return-head of about 50 feet, and, leaving the entrance between, have an insulated breakwater of 100 feet in length at the base. I have endeavoured to give such a form to this pier as will effectually protect vessels from the east and *north-east* winds, which appear to me to be the only points to which this part of the

APPENDIX C.

NAIRN.

No. 255.
Gibb, on Improving the Harbour, and Estimate.

Frith is seriously exposed. I propose that the pier shall be founded 1 foot 6 inches under low-water of a best stream tide, and carried up in the form as per transverse section, having a very great slope or batter on the outside, as it is well known that nothing tends so much to weaken the force of a *wave* as to allow it to spend its force on a sloping body. The breakwater is to be founded the same depth, and agreeably to the transverse sections; but as it is only intended to deflect any waves that pass round the pier-head, and prevent them from entering the harbour in a body, it need not be carried much above high-water of a stream tide, and two pawls fixed on the top of it; at the head of the harbour the sloping hammer-blocked wall O P and platform C M are to be formed, from the end of which the tunnel aftermentioned will commence.

The interior of the harbour, for 110 feet wide from the inside of the pier, or say within the space A B C D, is to be excavated to rather under low-water of best stream tide, and from C D to E F is to be left with a *sloping beach*, with a rise of one foot perpendicular to every ten horizontal, where it is intended to draw up and repair boats or vessels, and as a place from which timber can be most conveniently loaded into vessels. As it is only the flood-tides which pass along this shore, the ebb-tides running principally on the north shore, I see nothing to premonish that there will be a great accumulation of beach or sand in this harbour; I would, however, particularly recommend that a provision should be kept in view for occasionally removing any deposition which may happen to take place: I therefore advise that a tunnel built of stone should commence at the upper end of the platform C M aforementioned, agreeably to the plans and sections, to communicate with a *basin* to be excavated in the lowest part of the town's ground, as shown on the plan.

This tunnel to be partly arched over for the convenience of a carriage-way, and partly left open. Near the mouth of it a turning sluice is to be fixed; and as the water will flow through the tunnel into the basin, the turning sluice (when necessary) can be shut at high-water, and at low-water the sluice can be opened, when the whole of the water retained in the basin will be let off, which will effectually scour the harbour. It may, however, be only requisite in the first place to build the pier and breakwater, excavate the harbour, and slope the brenls, agreeably to the plans and sections, until experience has shown how far the tunnel and basin will ultimately become necessary, as they can be executed afterwards without the smallest inconvenience to the harbour.

With regard to raising the road to the Fishtown between the Maggot and Black's Fen, I shall say nothing at present further than advise that the spare stuff procured in excavating the basin after the banks are formed shall be wheeled to level up the said road.

The following specifications, with reference to the plans and sections, will show the manner of executing the works:—

A row of piles, averaging 9 inches diameter by 7 feet long round the pier, must be driven down until their heads be under low water of a best stream tide, at a distance of not less than 3 feet between centre and centre, and with a slope or batter nearly as per transverse section. On the inside of these piles all round, *wall-pieces*—say two joined in depth by dowels, to make 16 inches deep by 4 inches—to be trenailed to the piles in lengths of not less than 9 feet, that each may lay hold of four piles: their upper surfaces being rather under low water, and the ends half cheeked to receive each other after passing the east corner of the pier *outside* for about 100 feet, it will be quite sufficient if the piles are driven for 3 feet under the surface of the beach without regard to low water. Great care, however, must be taken in attending to the acclivity of the beach, and that the lefts are done in lengths of not less than 9 feet, and that each portion must run on a level bed. When the piles and wall-pieces shall have been affixed as afore described, the sand and gravel must be excavated from within for 18 inches deep under low water all along the side of the pier, and round the east corner for 100 feet, where the masonry and hearting of the pier are to be founded in the form and dimensions as per transverse sections, and on a layer of heather at least 2 *inches thick*. The whole of the stones composing both the outer and inner face are to be placed on edge, radiating as per section. Those facing *seaward* to go from 2½ feet to 3½ feet into the wall, having their outer heads rough as they came from the quarry, with joints rough picked or scabbled, that they may join pretty fair to each other, but nothing like close-jointed masonry is expected. The stones facing the inside of the pier to go from 20 inches to 2 feet 9 inches into the wall, and have their outer *faces*, *joints*, and *beds* scabbled or rough picked, so that they may fit pretty fair to each other.

The hearting of the pier to be composed of rubble-stone, close packed, with pawls as per transverse section. The parapet to be built with stones dressed in the same manner as the inner face of the pier, laid in good lime-mortar, prepared from Portsoy shells and clean sharp sand, in the proportion of one to four.

The top course or coping on the inner face of the pier to be rounded off on the upper edge, and squared back for 2½ feet, on the top of which, and 1 foot within the edge of the pier, a half-bank 6 inches broad and 3 inches thick is to be fixed, with prick-bolts to keep the whole together. The upper surface or platform of the pier is to be paved with hammer-dressed rubble-stone about 1 foot deep, rounding a little towards the inside, so as to form a fair carriage-way, into which 9 large stones are to be laid for fixing mooring-rings.

Proper defenders of timber, 6 feet between centre and centre, are to be fixed with bolts on the inner face of the pier.

The breakwater to be piled, walled, and founded in the same manner as the pier, to the form and dimensions as per plan section; only the whole of the external faces of the stones may be rough as they come from the quarry.

The sand and gravel to be excavated to rather under low water between the pier and breakwater, within the space A B C D: from C D to E H is to be sloped up at the rate of one perpendicular to every ten horizontal; and should the tunnel, after described, not be executed at present, the slope will be continued from B C round by H G, and the inner wall of the pier terminate at H, being the head of the sloping beach.

Quality of Materials.

The stone to be of the best quality that can be procured in the adjacent quarries to the westward near Sea Bank.

The timber to be all of sound home fir, such as can be procured in large quantities in the neighbouring forests.

	£	s.	d.
Total estimate of the foregoing work . .	£2,962	14	0
To contingencies on the whole at 10 per cent. .	296	5	8
	£3,258	19	8

APPENDIX C.

NAIRN.

No. 255.
Gibb, on improving the Harbour, and Estimate.

Specification for a Tunnel Sluice and Inner Basin for Scouring the Harbour of Nairn.

The space from E to M, where it enters the side wall of the turning gate, to be formed with *piles, cells, and planking;* the piles from 6 to 9 inches diameter, driven not more than 3 feet apart, and crossed with cells 4 inches square trenailed down to the piles, and are to be covered with 3-in. plank nailed to the cells. The sides O P are to be formed with hammer-blocked rubble, sloping to the respective sides and placed cage-wise, at least 1 foot deep. The spaces between the pile-heads and cells under the platform are to be close packed with rubble-stone for at least 10 inches deep, before the platform is laid on.

The platform for the recesses of the turning gate are to be formed with *piles*, *cells*, and *planking;* the masonry, &c., as per plan and section.

After the piles have been driven as per plan, the gravel and sand are to be taken out for 12 inches deep, and the space close packed with rubble-stone and good lime-mortar, after which, the transverse cells *a a a a a a* are to be laid on for the whole width of the walls, and opening the middle one, to be 12 inches by 6, and all the rest 6 inches square, and be firmly trenailed down to the piles, and between the cells the space is to be close packed with rubble-stone and good lime-mortar, after which, 3-inch plank for the whole width of the opening and thickness of the said wall *close-jointed* is to be nailed to the cells flush-bedded in good lime. The masonry of side walls for 10 feet in length on each side is to be done with *close-jointed* ashlar-work laid in good lime-mortar, and pointed with Roman cement, and behind the walls must be well puddled to the extremity of the front, and also to join with the puddle of the tunnel. The recesses on each side for the gate to be 4 inches deep. The gate to be made to turn on pivots or joinings at top and bottom a little to one side of the centre, so that with the assistance of rack-work it can be thrown open all at once. The mode of framing, &c., will be best shown by an enlarged drawing, which can be furnished when the work is about to be put in hand. The circular tunnel to be at least 80 feet long, to join the inner end of the platform as per plan, to be built with hammer-dressed stone from 12 to 18 inches deep (observing to keep the deepest for the sides), and laid in good lime-mortar and completely puddled in bottom and sides as per section, and the ground afterwards levelled on the top to suit as a *road* to the pier.

The inner end of the tunnel as far as *q r* on the basin to be paved with rubble-stone to a batter of two horizontal to one perpendicular. The basin to be 9 feet deep at the end next the tunnel and 8 feet deep at the other end under the present surface, and to be 300 feet long and 200 feet broad, formed with slopes all round of *one and a half horizontal to one perpendicular*.

Part of the stuff taken from the excavation to be formed into regular banks all round equal with the level of the pier for 12 feet in breadth at the top, with a slope of two horizontal to one perpendicular on the *outside*, and the remainder of the stuff to level up the road leading from the pier to the Fishtown between the Maggot and Black's Fen, and to make up the low ground adjacent.

Quality of the Materials.

The materials described to be used in the former specification are also applicable to this latter, excepting the materials for the turning gate, for which an enlarged drawing is to be furnished.

Estimate for the Tunnel.

Basin and its appendages . . .	£486 4 0
Contingencies, 5 per cent. . . .	24 6 0
	£510 10 0

Charles L. Cumming, Esq., of Roseisle,
Provost of Nairn.

JOHN GIBB.

No. 256.

No. 256.
Telford, on improving the Harbour.

Letter from Mr. Telford on improving the Harbour.

SIR,

Nairn, September 12, 1816.

AFTER maturely considering all the circumstances connected with the Nairn shore and river, I am convinced that the only true mode of acquiring lasting accommodation is by cutting a new channel for the river, from the bridge down by the Wauk-Miln, and through the beach-ridge immediately into the sea, and constructing a wharf-wall along the western river-bank, within the line of the said beach-ridge. By rendering the river-course so very short and direct, its current will throw the bar below low-water mark, and thereby always preserve from 10 to 11 feet water at ordinary springs. It will, in my opinion, be quite unadvisable to attempt any other scheme. I shall therefore make a plan, report, and estimate agreeable to what has been described, and transmit the same to the Parliamentary Commissioners. The expense will, I expect, be about 3600*l.*; and, from their former resolution, you will be aware that, unless a moiety of this sum is provided without delay, the opportunity of obtaining public aid towards this desirable improvement will be for ever lost.

I remain, &c.,
T. TELFORD.

To the Town Clerk, Nairn.

No. 257.

The Petition of the Provost, Magistrates, and Town Council of the Royal Burgh of Noirn, to the Convention of the Royal Burghs of Scotland,

No. 257.
Petition of Magistrates, on the want of means for repairing the Harbour.

HUMBLY SHEWETH,

Nairn, July 1, 1834.

THAT so long ago as the year 1812, and afterwards in the year 1818, the petitioners memorialised the Honourable Convention in regard to the then state of the harbour of Nairn, craving aid to enable them to meet a proposition, agreed to by the Commissioners for Highland Roads and Bridges, for erecting a proper wharf-wall, and cutting a canal from the bridge of Nairn to the sea. These improvements so projected were according to the plans of Mr. Thomas Telford, and intended to be executed strictly in conformity thereto, the estimated expense being about 4000*l.* The Commissioners for Highland Roads and Bridges, after very particular investigation into the circumstances of this burgh, and surveys as to the eligibility of the undertaking, having sanctioned the plans, ultimately defrayed a moiety of the estimated expense, the other moiety having been made up by local private subscriptions, by 3000*l.* received in like manner from London, by the liberal grants from the Honourable Convention, and by anticipated appropriations of the very limited funds

No. 257.
Petition of Magistrates, on the want of means for repairing the Harbour.

of the burgh itself, which are, on an average of years, hardly adequate to meet the necessary expenditure.

That the wharf-wall and canal were accordingly completed in the year 1820, but it was soon found that the rapidity of the mountain torrents which flow into the river Nairn, combined with rapid currents running westward in the Moray Frith, would speedily destroy all the works that had been finished, unless two jetties had been erected at the extreme points of the wharf-wall, and also a weir to divert the overflow of fresh water from the channel of the newly-cut canal which leads through the harbour; to effect which additional works the Town Council had to borrow money, and afterwards (in 1823-4) they were compelled to sell almost the whole of their heritable property—say to the amount of about 3500*l.*—to repay that loan and other debts incurred for defraying the original works at the harbour, as well as in erecting a new burgh gaol.

That, notwithstanding these great exertions and heavy expense, the whole of the banks of the canal, the jetty next to the sea on the wharf-wall, and the stone-work which projected into the sea, were, in the course of one day, almost totally swept away by fresh-water torrents during the memorable and awful floods of 1829; thus rendering the harbour of Nairn almost entirely useless, excepting to very small craft at spring tides, and to fishing-boats. Nay, the canal leading to the wharf is frequently so blocked up that even boats have great difficulty at times to steer through it to their moorings off the wharf-wall—the obstructions arising from the accumulations of sand and shingle driven into the harbour by easterly winds and currents, against which there is not the least protection on entering the mouth of the river.

That, in addition to what has already been stated, the Council has annually, since the disaster alluded to, been obliged to encroach on the very stinted resources of the burgh, which have been required for police and other purposes, to defray the expense of protecting the remaining part of the harbour from utter dilapidation. A statement of the income and expenditure of the burgh for five years immediately preceeding 15th October 1833, as annexed, is submitted to the Honourable Convention, by which it will be seen (the tangible heritable property of the burgh having been already alienated, excepting a few pendicles of little value) that, unless extraneous assistance is afforded to the Town Council, the inhabitants of this burgh and of the neighbouring districts must continue to receive great inconvenience, and be put to heavy charges on all sea-borne commodities importable—say coal, lime, groceries, and haberdashery goods—and be obliged to go to the neighbouring ports of Inverness and Findhorn (distances of 20 and 18 miles from Nairn) to export their grain, cattle, potatoes, fish, and wool, while, at the same time, the local position of the burgh of Nairn commands every desirable requisite for marine intercourse.

Your petitioners submit that, when the Caledonial Canal was first projected, it was deemed an object of importance to have a safe harbour at Nairn, since, from the coast of Banffshire to Fort George in Inverness-shire, there is only one harbour, viz. Burghead, on the south side of the Moray Frith, accessible during heavy gales, which prevail from the south-east during the winter in this district; and the want of such a place of refuge has been the occasion of serious loss of life and property during the last few years; for, although Cromarty (justly styled "*portus salutis*" when once entered) is nearly opposite to Nairn on the north-west side of the Moray Frith, yet that bay and harbour are land-locked, and therefore approached with dread and difficulty during the heavy gales of winter. And your petitioners also submit, that Nairn is the residence of a numerous, poor, but industrious race of fishermen, numbering *forty* boats to the autumn herring-fishery, and *twenty* boats and upwards to the cod, ling, and haddock fishing—together more than *sixty* boats—who, with all the disadvantages of distant markets for their fish and dangerous navigation, have long been settled here, and are unwilling to emigrate, though, when endeavouring in the usual course of their vocation to make for the port, they are often driven from it in dismay, not daring to enter in time of gales when the channel is much impeded. Almost every year one or two boats are stranded or wrecked at the mouth of the harbour of Nairn. About six boats of the above sail from the neighbouring village of Delnies; these have no other protection during the winter than the harbour of Nairn.

Further, your petitioners beg to state, that there is at present a ferry-boat plying between Nairn and Cromarty of 20 tons burthen, which, were the Nairn harbour always accessible even to it, would be of immense public importance, by shortening the route of communication from the southern to the northern counties nearly 60 miles; while, at present, travellers are obliged to take the circuitous route *viâ* Inverness. Your petitioners feel assured, that were the harbour of Nairn repaired, as they now contemplate, efforts would immediately be made to establish a steam-boat between this place and Cromarty, and thereby ensure a constant and safe communication between the extensive and highly cultivated districts of the opposite coasts of the Frith.

Your petitioners are anxious to repair the canal-banks and protect the wharf-wall of the Nairn harbour from the encroachments of the sea, which threaten speedily to undermine and carry the whole away, and also to make a safe rendezvous within the wharf-wall for the fishing-boats belonging to the burgh; the estimated expense of which is at least between 1500*l.* and 2000*l.* The petitioners are willing to mortgage the shore-dues—on an average about 50*l.* per annum, deducting 20*l.* for contingent expenses of necessity laid out on tear and wear—to pay for the interest of a loan to effect the contemplated repairs. Say at 4 per cent, this would produce

effect the contemplated repairs. Say at 4 per cent, this would produce . .	£700	0	0
Private subscriptions might amount to	150	0	0
	£850	0	0
But even after these were realised a deficiency of	650	0	0
remains to make up the sum of the smallest estimate—say	£1500	0	0

—without which it would be of no avail to attempt the repairs proposed to any effectual purpose.

Finally, your petitioners submit that the burgh of Nairn is not in arrear in Conventional Assessments.

May it therefore please your Honours to take into consideration the peculiar and embarrassing circumstances of your petitioners, and to grant such aid for the repairs of the harbour of Nairn as shall appear just, under the distinct pledge, on the part of the petitioners, that the same shall be *bonâ fide* applied accordingly.

And your petitioners shall ever pray, &c.

ISAAC KETCHEN, Provost, and 15 others.

No. 258.
Mitchell, on remedying damage done by land-floods.

No. 258.

JOSEPH MITCHELL, Esq., C.E., *on the best means of remedying the Damage done to the Harbour by Land Floods.*

Inverness, January 24, 1835.

SIR,

IN compliance with the minute of the Town Council of Nairn, dated 11th August, 1834, I took an early opportunity of surveying very carefully the present harbour at that place and the adjacent shores, with the view of determining the best mode of improving the accommodation for shipping and the numerous fishing-craft belonging to the port.

I directed my attention particularly to the state of the present harbour, which I found in the same dilapidated condition described in the memorial of the Town Council to the Herring Fishery Board, dated July, 1834. It appears that the only part of the original structure now existing is the wharf-wall and upper jetty, the land-floods having completely destroyed the banks of the new channel formed between the bridge and the wharf, and carried down a great accumulation of gravel and rubbish, which the diminished slope of the stream and the contrary action of the tide have caused to be deposited in irregular banks within and about the entrance to the harbour. This accumulation of course varies according to the state of the land-floods at different periods of the year; sometimes a tolerably open channel is cut, while at other times it is so blocked up by the effects already described that the depth is scarcely sufficient for the admission of fishing-boats at high-water.

Another cause which has a tendency to obstruct the entrance to the harbour arises from the drifting of the sands during easterly winds from the great banks immediately to the east of the harbour. Being intercepted by the river channel in their progress westwards, they are deposited at the entrance; and during the summer, when the river is low, accumulate in a greater or less degree until scoured away by the winter floods. The result of these united causes is, that the position of the channel undergoes frequent alteration, both in regard to direction and depth.

There is no doubt, when the plan of the present harbour was originally projected, that it was contemplated to admit into the new channel only such a portion of the river as would effectually scour and keep clear the face of the wharf and entrance to the harbour, the surplus water being directed into another channel. Had the works, therefore, been constructed of sufficient strength and on sufficiently secure foundations, such an arrangement would perhaps have effected the object in view. But the only part of the works which was founded on rock was the wharf-wall now standing; and the ordinary precaution of piling appears to have been neglected in securing the foundations of the other portions. In contemplating, therefore, the restoration of the harbour according to the original plan, it would be necessary in the first instance either to procure a rock foundation or to adopt such artificial means of securing the works as would necessarily from their extent be attended with great expense, and perhaps prove ultimately imperfect. Were the river Nairn not exposed to such heavy floods, this restoration might be entered upon with comparative security; but since the great flood of 1829, it is difficult to calculate the effects which might be produced, and the most careful precautions might eventually fail of success. After the most mature consideration, therefore, I was of opinion that it would be inexpedient to incur a large expense under circumstances so precarious; and my attention was naturally directed to the adjacent shores, with the view of fixing upon a position more advantageous, and exempted from the effects of the river-floods.

The beach to the eastward of the present harbour presents a continued flat of level sands, extending for a great distance between high and low water mark. On the west side, however, the beach gradually diminishes until opposite the quarry-holes at the termination of the Links, where the distance between high and low water is only 220 feet. This situation appeared to me well adapted for the construction of a harbour; there is a good rock foundation for the whole space, and the depth of water at the immediate entrance will be fully 15 feet at spring tides, whereas, neither at the present harbour, nor in any other position along the shore, can this depth be obtained without a much greater extent of beach, and consequently of building. Moreover, this situation is in a great degree exempted from the accumulation of sand; for the river channel, as I have already mentioned, intercepting the progress of the drift from the eastward, I apprehend that there will be little tendency to any obstruction of this nature. I have therefore drawn out the accompanying plan and sections to suit this position, by which, as I have said before, a depth of water will be obtained amply sufficient for the trade of the place, while a great extent of wharfage and accommodation will be afforded to all the vessels and fishing-craft connected with the port.

The accompanying plan exhibits an outer and inner harbour; and the direction of the piers and breakwaters is so laid out as to resist and throw off the heavy swell which sets in on this quarter from the east and north-east. The entrance, which is 55 feet wide, is calculated to afford the easiest access; and any portion of the swell which may enter will necessarily expand itself on the extended beach of the outer harbour, without, in any degree, affecting vessels or boats lying in the interior. By this arrangement, I am of opinion that the security of vessels lying within this harbour is effectually provided for. The construction of the piers, however, may possibly cause some accumulation of sand, although I do not think it will be in any degree considerable, or such as may not be removed by horses and carts in the course of a few days once a-year; but in the event of this obstacle exceeding what there is at present reason to expect, the situation is favourable for the formation of a scouring basin, which may readily be constructed in the quarry-holes already excavated, almost to the required dimensions, and which would remedy this inconvenience, should such afterwards be found to exist. I propose to excavate the greater portion of the interior of the harbour to the level of low water of spring tides, so as to suit the accommodation within to the depth of water at the entrance.

I calculate the expense of constructing these works at 4430*l.* 8*s.* 4*d.*, as per the accompanying estimate.

If the harbour is constructed as now proposed, the town and neighbourhood of Nairn must be greatly benefited. It will form the natural seaport for the whole district of Strathspey and Badenoch; besides the great facilities which it must necessarily afford to the trade of the whole county. In short, I have little doubt that all the advantages set forth in the memorial of the Town Council to the Herring Fishing Board would ultimately be realized; and, from the favourable nature of the situation, the interests of the fisheries would be in a special manner promoted.

I am, &c.,
JOS. MITCHELL.

To the Provost, Nairn.

No. 259.

Messrs. GIBB and MITCHELL, C.E., *on the means of counteracting the injurious effects of Land-Floods.*

No. 259.
Gibb and Mitchell, on counteracting the effects of Land-floods.

1837.

IT is perhaps of little moment now to state that what was originally intended to prove of signal benefit to the preservation of this harbour has proved the chief cause of annoyance, namely, allowing the river Nairn to pass through the channel towards the harbour with so great a fall, without any intermediate check, and without any spill-water to take off part of the land-floods, which come down with great velocity, and bring with them a vast accumulation of sand and gravel, which not only lessens the depth of water in the harbour, but tends to form irregular banks throughout the whole of the entrance *channel*, besides distorting the berthage and rendering it very difficult to maintain vessels at their moorings.

Now, although it is indispensable to maintain an efficient scour, and that to do this perhaps the whole of the water of the river in its ordinary state should pass through the harbour and navigation channel, with the view of preserving its depth and keeping it clear, it is of the utmost importance that means should be taken to reduce its present fall and likewise to provide means by which a greater portion of the land-floods shall be made to pass in a different direction, and that the portion which must inevitably be allowed to pass through the harbour and navigation channel shall have its velocity diminished, so as to prevent it from injuring the harbour-works or distorting the berthage.

The swell or inrun of the sea having also been found very annoying to shipping lying in the harbour, means should be taken to check this.

With the view of remedying the evils which have been noticed, it is proposed that a weir be constructed across the river where there is a rock foundation at the place represented in the plan, with an embankment continuous from this weir across the low ground; that this weir be carried to a height so that the river in its ordinary state shall have no fall from the bridge to the top of the weir, but merely its own volume to impel it forward, and that, when it falls over the weir, the bottom below having but little inclination, the velocity may not occasion a destructive acceleration as heretofore.

The embankment, which is to be continuous from the weir across the low grounds, being several feet higher than the weir, will prevent any water from passing over it; and when the land-floods bring more water, the whole of the space on the right bank being nearly as low as the weir, with a much larger surface, the flood-water will take this direction, and, being checked by the lower embankment, will naturally rush down the old channel of the river, and thereby give no annoyance to the harbour.

It is also proposed to remove the upper jetty of the wharf, so that the water of the river may produce a more uniform effect in keeping the berthage clear.

As the fishing-boats require a large space for their accommodation, it is proposed to construct a rubble wall from the upper jetty of the present wharf-wall upwards, and the space in front of it to be used as a boat-harbour, where there will be ample room.

It is proposed to extend the present wharf about 100 feet lower down by driving piles in front, and having a sloping wall, and cover a part of the top by a wooden platform.

With the view of keeping the river in a regular channel and checking the inrun of the sea, it is proposed to construct a range of jetties on the left bank, and have a warping and mooring post in the centre of each, all as represented in the plan, the form of the jetties being shown by a drawing on an enlarged scale.

On the right bank from opposite the lower end of the wharf-wall to the extremity, a distance of 1200 feet, it is proposed to drive a row of small piles to the depth of 7 or 8 feet, and on these construct a low work (as represented on the plan and by an enlarged drawing), for giving effect to the scour at low-water, and for preserving a uniform channel. It is likewise intended to construct at the extremity of this low work a wooden beacon, having a platform considerably above high-water mark, where several persons may stand and make fast a vessel on arrival, or when vessels are about to depart, from whence they can most conveniently make sail. This beacon is also represented by an enlarged drawing.

JOHN GIBB.
JOS. MITCHELL.

No. 260.

Messrs. LESLIE and MITCHELL *on constructing a Breakwater in Nairn Harbour.*

No. 260.
Leslie and Mitchell, on constructing a Breakwater.

Inverness, May 10, 1845.

HAVING carefully examined the harbour of Nairn and the adjoining shores, together with the course of the river from the dam of the flour-mills downwards to the sea, and having considered the previous plans that have been proposed for the improvement of the harbour, and heard the opinions of several members of council, and of fishermen and others well acquainted with the locality, we have agreed on the following recommendations:—

We are of opinion that the first thing that ought to be done is to construct a pier or breakwater along the east side of the river channel from the lower end of the gravel bank opposite the old wharf, out to low-water, or about 1300 feet in length, and bending to the westward at the outer end, so as to point nearly in the direction of the entrance to Cromarty Frith, and nearly similar to what has received the sanction of the Board of Fisheries.

It would be very expensive to construct this work of stone, because the western foundation would not be secure without going down to the rock, which is at a very considerable depth; and therefore we agree in recommending a pier consisting of main piles of Memel timber, at the distance of 10 feet apart, with sheeting piles on the inside face to keep the hearting from being undermined. The remainder of the western face and all the eastern face will be planked with half-round timbers, and the interior filled in with stones and gravel.

As it is important to make this serve as a pier or roadway as well as a breakwater, it will be necessary that it should be heightened about 2 feet beyond what was proposed, and that it should be 2 feet wider, with a railing on the east side.

APPENDIX C.

NAIRN.

No. 260.
Leslie and Mitchell, on constructing a Breakwater.

We are informed that there is no sea-worm at Nairn to attack the timber, otherwise we should have proposed that the lower part of the piles should be scupper-nailed. The timber will, however, require to be carefully noticed, and, if there be any appearance of worm, it must be either scupper-nailed or occasionally scraped, scorched, and tarred.

An extension of 300 or 350 feet farther would, according to the soundings, give a depth at low-water of 8 feet, which would allow steamers to come up to it at all times in moderate weather.

The nature of the bottom has not been ascertained yet with sufficient correctness to enable us to speak as to the nature of the work that would be required for this extension. But if the ground be such as to admit of piles being driven, we should recommend that it be constructed of open frame-work.

We are of opinion that the eastern pier or breakwater would very materially shelter the harbour from the effects of easterly gales, and that most probably the works proposed by Mr. Gibb on the west side of the channel will not be required—at all events we think that the eastern pier ought to have a trial by itself first.

The greatest evil of the harbour of Nairn is the quantity of gravel brought down by floods, and it is difficult to say whether the good which the river does in scouring away the sand, or the mischief which it does in bringing down gravel during floods, predominates. This question was treated by Mr. Mitchell in his report of the 24th of January, 1835, wherein he recommends the construction of an entirely new harbour to the west of the bathing-house. That plan has undoubtedly many advantages for a mere high-water harbour; but as connected with the formation of a deep-water pier, which was not then contemplated, but is now reckoned an important object, it is less suitable than the present harbour.

We think that it will be essentially necessary to adopt some measures for preventing heavy floods from passing through the harbour. To accomplish this, and at the same time to allow a quantity of water equal to the ordinary winter-flow to pass through the harbour so as to clear away the sand, we recommend that there should be an embankment thrown across the upper part of the harbour, with self-acting sluices in it, which would shut during floods and send all the flood-water into the old channel of the river. We think that three openings of 10 feet each would be ample space, as that would be equal to three times the width of the sluices which admit the water into the flour-mills a little above the town, and which in dry weather are capable of running considerably more than the whole water of the river.

Probably a low weir may be required to cause the ordinary water to run through the sluices, and an embankment will be required to be thrown across the present channel, which keeps along the south side for some distance below the bridge.

The proposed embankment with the sluices is almost in the same situation as that recommended by Mr. Gibb, as he ascertained that there was a rock bottom there. Mr. Gibb does not seem to have made provision for the ordinary water getting into the harbour, but, on the contrary, excluded the river-water until it was high enough to run over a weir, which is exactly the reverse of what we now propose to do.

Should this plan of the embankment and sluices be executed, there would be a roadway formed over the sluices, and it would be necessary to have a road carried along the south side of the harbour from the cross embankment towards the gravel bank, upon which the new eastern pier is proposed to abut, and the portion of the harbour between the sluices and the upper end of the old quay, after it ceases to be filled up with gravel, may be deepened to form a convenient and sheltered harbour for boats and other small vessels.

The plans here proposed for the sluices and embankment, although essential in our opinion for keeping the harbour clear, need not interfere with the erection of the eastern pier or breakwater, which we think ought to be executed forthwith, as we are quite convinced that it would tend much to the shelter and safety of the harbour.

JAMES LESLIE.
JOS. MITCHELL.

INVERNESS.

Appendix C.

Inverness.

No. 261.
Evidence taken on the 23rd Sept., 1846, with additions.

No. 261.

Examining Commissioner—Captain Washington, R.N., assisted by Captain Vetch, R.E., F.R.S.

Present:—Provost Sutherland, Dr. Nicol, Mr. A. Mactavish, town clerk, Mr. D. Maclennan, Comptroller Cumming, Mr. Neil Maclean, land surveyor, Mr. H. Morrison, ditto, Mr. George Mackay, jun., ditto, Bailie Maclean, Bailie Lawrence, Mr. D. Fraser, jun., Dr. J. Stewart, Dr. Forbes, Dr. Mackenzie, Dr. T. Mackintosh, Mr. George Mackay, Mr. Robert Mackay, Mr. Thomas Falconer, Collector Cameron, Captain Sharp, Mr. Shaw, Mr. J. Smith, Mr. K. Douglas, Mr. Urquhart, Mr. Cameron, harbour master, Mr. K. Ross, &c., &c.

Mr. Alexander Mactavish, appointed town clerk in January, 1839, was a magistrate and member of the Town Council for some years before, and has resided in Inverness since 1810. The port of Inverness is constituted by ancient royal charters, ratified by Acts of Parliament. By these rights, what are called the old dues are created. In 1808 an Act was obtained for improving the harbour and authorizing additional dues. The extent of shore on which Inverness can claim shore and harbour dues, extends, as is admitted by all, from Carnlaw on the east to Clachnaharry on the west. The additional dues authorized by the Act of 1808 were not exacted till 1816, and in that year the old rates were fixed at 332*l.* per annum, being the average for the three preceding years. The old and new dues, for the sake of convenience, are set and collected together. The old are paid to the town, and the new dues expended in improvements and in liquidation of the debt due by the harbour to the town. In 1833 the debt amounted to 3365*l.* 6*s.* 2*d.*; in 1841 to 4761*l.* 3*s.* 11*d.*; and at this date it is somewhat less than 4000*l.* This debt is exclusive of the annual payment of 332*l.* for old dues. The principal alterations and improvements were made on the harbour in the years 1813, 1814, 1816, 1817, 1818, 1826, 1837, 1838, 1839, 1840, 1843, 1844, and 1845; those of 1813, 1814, and 1816, in consequence of, and preparatory to, enforcing the Act of 1808. The subjoined abstract of expenditure since the year 1813 will show the exact sums laid out by the town on the harbour. An abstract of the revenue from the same date is also subjoined; an abstract is also given for the five years preceding, viz., from 1808 to 1813. The Town Council have always had the government of the port. There is a Harbour Committee formed by the Town Council, several of whom are well acquainted with these matters; and there are at present in the Town Council some shipowners and captains of vessels. He did not remember a year when there were not several of such in the Town Council. The number of councillors is twenty-one. The Council had made inquiries into the state of the harbour, and employed Mr. Mitchell, engineer, to superintend repairs. Mr. Morrison, surveyor, was employed to make plans of the river and harbour in 1842, and also of the town and town property. There were no plans of Mr. Mitchell in the hands of the Town Council, but they had those of Mr. Morrison. Within the last twenty years many expressed dissatisfaction with the accommodation afforded by the harbour; and although, from the insufficiency of the harbour, many vessels went to the canal, he only recollected one written complaint, which was from a company in Aberdeen, concerning an accumulation of stones at the Thornbush Pier, from which ships were in danger of being damaged, and requesting that they should be removed. This accumulation was principally formed by stones loosened in the bed by the vessels alongside of the pier, and from the sides of this bed. The complaint was attended to and its cause remedied. The enlargement of the Thornbush Pier, so as to admit steam-boats, was done by the Town Council. In 1842 the Town Council proposed to obtain an Act of Parliament to carry out repairs on the harbour, &c. Plans of the harbour were necessary; but differences of opinion as to the best plan prevented their execution. There is a feeling that there should be a special harbour trust; and it may be passed as a separate Bill or not. The fund derived from the harbour, arising from anchorage and shore dues, last year amounted to 1180*l.*

There was a rapid improvement in the trade; and he had no doubt that, if they are not interfered with by the canal, the Town Council will be quite able to make the harbour themselves. The income, during the short time the canal was shut up, increased by about 340*l.* per annum. The Thornbush Pier, or Steamboat Pier, was built at different periods, but much extended in 1838. Clause 11th of the governing Act mentions "deepening, scouring, and cleaning the harbour;" but, excepting at the Thornbush, none of these improvements had been lately attended to, and there only to a limited extent, alongside of the quay. The Thornbush Pier is of great use to the town; since it has been deepened abreast of the pier, it can keep a vessel afloat drawing 8 or 9 feet, at low water. He thought that improving the harbour would be of immense advantage to the prosperity of the town. He wished for a new Bill and a separate board of management for the harbour. The Bill has been prepared, and the heads of it printed and circulated. A plan of the harbour has been made out, and is now before Parliament. He did not think that the improvements should be made on the western side of the river; but the engineer should decide on that point. He said it was difficult to bring up a ship when the river was high; and that the river very likely brought down some stones, but the quantity was very trifling. He was of the opinion of Captain Vetch, that the stones, gravel, &c., were deposited farther up the river, at Ballafeiry and about the Islands. In building houses, &c., people had been in the habit of throwing earth into the river, but this practice has been discontinued. He came to the Inverness Academy in 1810, and knows a stone, of no large size, which has been in the same place in the river since that time, for he was in the habit of fishing on it; and he can say that there is little difference in the bed of the river from that time. There are also a number of weirs in the river, which intercept stones and gravel on their way down, and many of these overlap each other. There is one weir at the source of the river, called the Canal Weir; there are also Lady Saltoun's Weir; the Laggan Weir; there is one at Dr. Nicol's manufactory; the Mills of Bught Weir; and the Town-water Weir, in all six, which must be of much service in impeding mud, gravel, &c., from coming to the mouth of the river. The Ness has a fall of about 40 feet in seven or eight miles. He knew

No. 260.

Evidence taken on the 23rd Sept., 1846, with additions.

that the levels of the canal had been taken, but did not know if they applied to the harbour. A vessel drawing 12 feet can come into the sea-lock of the Caledonian Canal at one-quarter flood.

Statement of Revenue and Expenditure of the Harbour of Inverness from 1806 *to* 1846.

REVENUE.

Years ending Michaelmas	£.	Years ending Michaelmas	£.	Years ending Michaelmas	£.	Years ending Michaelmas	£.
1808	206	1817	685	1827	645	1837	525
1809	240	1818	575	1828	550	1838	500
1810	256	1819	540	1829	565	1839	625
1811	275	1820	470	1830	520	1840	750
1812	295	1821	575	1831	500	1841	755
		1822	575	1832	500	1842	835
1813	290	1823	575	1833	500	1843	845
1814	345	1824	620	1834	420	1844	870
1815	360	1825	560	1835	434	1845	845
1816	555	1826	530	1836	510	1846	1,180

Total since 1813, £20,129. Averaging about £592 a-year.

EXPENDITURE.

The sums expended on repairs for the same period were as follows :—

Years ending Michaelmas		£.	s.	d.	£.	s.	d.	Years ending Michaelmas	£.	s.	d.	Years ending Michaelmas	£.	s.	d.
1808					303	7	4	1818	105	1	4	1833	19	8	2
1809					244	9	0	1819	22	15	4	1834		..	
1810					7	17	0	1820	41	8	2	1835	23	1	3
1811					9	1	10	1821	28	14	11	1836	17	12	7
1812					3	10	11	1822	8	18	0	1837	414	15	1
								1823	4	4	6	1838*	846	18	5
1813 1814					1,216	3	5	1824	17	11	7	1839	226	17	3
								1825	43	19	3	1840	93	8	11
1815					76	12	8	1826	132	13	0	1841	14	11	5
1816	Repairs .	821	6	4				1827	54	8	5	1842		..	
	Periodical interest on advances for the harbour by the town calculated down to 1st October, 1816 .	267	13	3				1828	57	12	7	1843	233	4	0
								1829		..		1844	130	15	6½
								1830		..		1845	145	13	7
					1,088	19	7	1831	13	3	5½	1846	40	4	0
1817					900	0	0	1832	20	15	3				

Total since 1813, £6,034 11*s.* 8*d.* Averaging about £177 a-year.

Captain SHARP corroborated this statement. The Inverness harbour-master had taken vessels drawing eight feet of water over the sea-lock sill at low water, and vessels drawing seven feet at low water in spring tides. The channel of the sea-lock has lately been deepened, but previous to this vessels could not be taken up at low water.

Mr. MACTAVISH is of opinion that the river Ness carries away very little gravel, &c., from the banks, and that it is a very gentle river in every respect. The principal deposit of sand, mud, &c., was made in the river by the burn of Holm, which, during a speat, carried down several thousand tons of stones and gravel, which were deposited about the Islands and at Ballafeiry. There was no plan of the river belonging to the town so far up as the Holm burn, except that of 1794. He repeated his statement, that he considered the river Ness very tractable, and offered no obstacle to improvements, but rather presented every inducement to carry them on. The harbour-dues were rapidly increasing, there being an increase of 335*l.* on the income of the previous year. The total revenue of the harbour for the last 34 years was 20,129. The expenditure on it during the same period was 6,034*l.* 11*s.* 8*d.*, exclusive of the annual payment of 332*l.* for old dues and the interest of the debt since 1816. Had no doubt that a new harbour was required in Inverness. There are new assessments laid on the people of this town for prisons, &c.; and the property within the burgh is now assessed for other purposes.

Mr. G. MACKAY said that some alarm was created by the fact, that those accustomed to see Loch Ness, say that in flooded seasons it used to rise only about two feet, whereas it now rises seven feet above its ordinary level; also that the outlet of the water from the loch to the river Ness is now ten times wider than it used to be, owing to the greatly increased length of the regulating weir, which would allow a larger quantity of water to pass at once. The cause of alarm was, that in case of a flood, the wide outlet of the lake would let off too much water, and endanger the town and country with flood. He added, that some years ago, in a tremendous flood, the water rose to within one foot of the top of the arches, and that if there was even very little more water, the bridge would certainly have fallen.

Mr. MACTAVISH corroborated this statement; and added, that the fears of the inhabitants were heightened by an old prophecy, to the effect that the bridge would fall when seven red-haired men were upon it. Had seen water within about two feet of the top of the end arch, but on a very extraordinary occasion, and only once in 36 years. No ice ever comes down the river. The old bridge was built in 1681, and the modern one in 1807.

Mr. JOHN CAMERON, harbour-master, examined.—Has acted for three years as harbour-master. He had been 30 years at sea in the coasting trade, and round nearly the whole British coast. Had been acquainted for about 45 years with the Inverness harbour. It had not been much improved since he had known it. There was not much difference in the quantity of water. There is no alteration in the mussel-scalps at the mouth of the river. Some parts of the bar at the mouth of the river are a

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* The Expenditure in 1837-9 was almost entirely on Thornbush Pier.

APPENDIX C.

INVERNESS.

No. 261.
Evidence taken on the 23rd Sept., 1846, with additions.

little shallower. He is 64 years of age. There were no stones carried so far down as the mouth of the river, but there are a great number between the Steamboat Pier and the New Pier. He could point out places, at the entrance to the Caledonian Canal, where mud, &c., had gathered to the height of four or five feet, and where he could once have ridden afloat, but could not do so now. He did not think this came from the canal. The water has been deepened farther out, and towards the north, by order of the Canal Commissioners. The material of the mussel-scalps at the mouth of the river is hard gravel and tough blue clay. Thought that a straight course from the Kessock Ferry would be the best entrance into the harbour, because the vessel gets into deep water soonest that way. Would have a dock between the Thornbush and the quays. A north-east wind was the worst for a vessel lying at the Thornbush quay; but never knew an instance of a vessel dragging her anchor or being wrecked: indeed, never knew of damage being done to a vessel to the amount of 1*l.* at the pier. Had no cause to fear damage in the straight course from the pier to Kessock Ferry. Thought that the ford of the river should be cleared of the stones that lie there. The quays of the dock are in a tolerably good state, at least, they are not tumbling away without being rebuilt. It is his duty to look after the harbours. Directed the pilots where to moor vessels, and they see that they are moored. Had often gone up the Caledonian Canal in vessels drawing from six to eight feet of water in all states of the tide. Thought that the mouth of the canal was filled up gradually, and had only been once cleared out. Would go round the Pentland Firth as soon as come through the canal, on account of damage sustained by want of proper attendance, there being sometimes a scarcity of hands at the canal. Conceived it no benefit to go by the canal. Found no difference in light-dues, for when he went there were no lighthouses. Has no tide-scale in the Ness; but there are figures marked on the New Quay indicating the depth of water. The tide reaches the quay at quarter flood, and rises three feet less than at the mouth of the river.

The COMMISSIONERS said that no engineer could design improvements in a harbour until he had set up tide-scales, and recommended some to be erected immediately.

Mr. CAMERON (continued)—The tide extends about half-a-mile above the Old Bridge. Kept an account of the arrivals and sailings of vessels, which are about 400 a-year, having increased during the last three years at the rate of 100 per annum. There were no buoys nor beacons to point out shoals in the Moray Firth. He thought that the approaches to the harbour required buoys and beacons; and would place one at the reef about a mile and a half below Fort George; another at Skate Bank, towards the east end; one at Petty; and another on the same bank at Kilmuir; one at the Middle Bank; one at the Meikle Mee; and a conspicuous beacon at the Longman Point; making in all six buoys and a large beacon. He has seen vessels run on Chanonry Point from want of a light; and, among others, the North Star steam-ship, several years ago, went on shore there within a mile of Chanonry Point.

Mr. CUMMING, comptroller of customs, said that 415 vessels entered the harbour here in 1845, the total tonnage being about 40,000. Six foreign vessels entered of 1000 tons. No vessels ever come here weather-bound. He was here when the Caledonian Canal was opened, but has no account of the number of vessels which passed through the canal. There are 225 vessels belonging to this port, but a number of them are very small; and there are 800 registered seamen for these. There are few fishermen belonging to this town, but a great many to the district. He thought that there were great capabilities for trade, and that a good harbour would very much increase the prosperity of the town. The exports are generally timber, wool, grain, cattle, &c.; and the imports—coal, lime, salt, manufactured goods, wine, &c.

“I am desirous to add, for the information of the Commissioners, that the basin of the Caledonian
“Canal, with an area of 15 to 20 acres, and wharfs now sufficient to afford accommodation for all the
“trade of Inverness, even supposing it should double or treble its present extent, has hitherto been
“open to the public at a nominal charge, and will, it is understood, be in future available at a fair rate.
“The Caledonian wharf is about the same distance from the Cross of Inverness as the Thornbush Pier,
“where the principal improvements are talked of being made. It would thus appear that there is suf-
“ficient wharfage, and a wet-dock open to the public, without incurring the expense of new erections,
“or the still more to be dreaded agitation of a question upon which the public mind is so much
“divided.

“These facts should settle the question so far as the shipping interest and the public are con-
“cerned; but the question of local taxation, and how far the revenues of the burgh are concerned,
“is a totally different matter, and appears to me should be settled on a totally different principle
“from harbour accommodation.”

Mr. MACTAVISH.—My objections to doing away with our own harbour, and substituting for it the basin of the canal, are:—

“1st, That the entrance of the Caledonian Canal had not been judiciously selected. It is exposed
“to the most prevailing winds, which prevent vessels from getting easily in or out. The river Beauly
“brings down a great quantity of mud and clay, which is continually shifting in a loose state in Loch
“Beauly. The prevailing north-west winds necessarily throw this shifting mud and sand upon and
“about the entrance of the canal; and the bottom at, and adjacent to, the entrance is said to be very
“soft.

“2nd, It is thought that, to make the basin of the canal an equally accessible, convenient, and
“sufficient harbour, as the new one proposed for Inverness, would be nearly as expensive as the
“making of the latter. The entrance would require a tidal basin or pier, and other securities; and
“this, if at all practicable from the nature of the bottom, could only be done at a very large expense,
“and even if made, the access would still be bad, and available only to small vessels, except at high
“water, and always filling up.

“3rd, The expenses of such improvements would of course fall upon the trade of Inverness.

“4th, There is at present an annual debt of 332*l.*, and also an ordinary debt of about 4000*l.*, due
“to the town of Inverness by the harbour. The Canal Commissioners will not readily undertake this
“debt.

“5th, The whole export trade, south and east of the river Ness (principally in cattle and sheep),
“would be carried through the streets and along the bridges, and would thus, as well as the whole
“import trade, be subject to pay the petty customs and pontage dues of the town, in addition to the
“canal dues.

“6th, The trade of the town cannot support two harbours, and therefore the present piers and
“quays of Inverness would be allowed to go to ruin, and the adjacent properties, both of the town and
“of private individuals, be much injured, and existing rights disturbed.

APPENDIX C.

INVERNESS.

No. 261.
Evidence taken on the 23rd Sept., 1846, with additions.

"7th, The canal as a harbour would be uncertain. The works at the western end of it, some "years ago, gave way; and it is feared that large portions of the works there are still insufficient. In "October, 1846, a considerable part of the bank, near Inverness, broke down before the weight of "the water. In a few hours, the whole of the water in the canal, between Dochgarroch and Muir-"town, was discharged into the river Ness; and if the Dochgarroch lock had not happened to have "been shut, and to have been sufficiently strong to resist the weight pressing upon it from Loch "Ness, the waters of that lake, raised as they lately have been, would have carried everything before "them, destroyed the whole works, swept away the bridges on the river, and flooded all the flat "ground in and around Inverness. This may, and is likely to, happen again. The part which lately "broke down is at a place visited by Captain Vetch, along with me, when here, being a portion of the "bank between the river and the hill of Torvean. Torvean is composed of sand and loose gravel. "The canal is cut out of the side of it; and the loose material removed from the hill forms, for "several hundred yards, the southern bank, which is constructed on what was once the bed of the "river Ness. The displaced current of the Ness washes the bottom of this bank, at a level of at "least 19 feet below the surface of the water in the canal.

"Lastly, the canal, at low water, would admit only small vessels, and would not, even at full tide, "admit vessels of greater burthen than those proposed to be accommodated by the improved works "in the harbour. Besides, the greater part of the trade of Inverness will be at the present docks up "in the town, as it is proposed to deepen the river up to those docks, so as to receive all ordinary "trading vessels, the lower quays being for steamers and large vessels which would not in any "event go to the canal—therefore Mr. Cumming's statement, as to distance, is fallacious."

Captain SHARP has been acquainted with this port for upwards of 24 years, and has seen very little change in the river in that time. He did not know any bar of the river but the scalps. He has found great difficulty sometimes in coming up the Firth; and thought that buoys and beacons were required, particularly for the bank of Fortrose, generally called Avoch Bank. He would propose two buoys on the edge of this bank; one on the Middle Bank; one on the Meikle Mee; a beacon on the Longman Point; one about one and a-half mile below Fort George; and one on the Middle Bank, between Fort George and Cromarty. He mentioned that the Northern Light Commissioners had proposed to buoy and beacon the Moray Firth, on condition that the Canal Commissioners and Town Council should dredge the Meikle Mee.

The COMMISSIONER said, that in the course of 30 years' experience at sea, he had never seen any place so much in need of buoys, nor round the coasts of Great Britain could a place be found so utterly deficient in them.*

Captain SHARP (continued)—The Chanonry Point light was of very great use. but the Cromarty light was only seen when passing it. Previous to 25th May last, when the Chanonry light was erected, he had known four vessels in one night to go on this point. The Town Council and inhabitants of Inverness have frequently sent memorials to the Commissioners for Northern Lights. Additional dues have been made in consequence of placing the lighthouse on Chanonry Point. He never took a vessel through the canal, but had frequently taken them as far as the basin, and considered the basin of great benefit to the town. The freemen of the town pay only half the harbour shore-dues, but this is to be done away with in the proposed bill. Banks of mud, &c., have been dredged from the mouth of the Caledonian Canal, and but for this, vessels could not come up at low water. The depth there is supposed to be about eight feet. He found great difficulty in entering the canal during a heavy north-west wind; and thought that a tidal basin or breakwater would be of service, but that there would be a difficulty in making one, from the unsuitable character of the foundation. He thought the foundation of the river harbour much better than that of the canal. There is a strong eddy running out of Clachnaharry Bay. It has been proposed to reclaim part of the land in Newton Bay (Loch Beauly), and there will be little difficulty in doing so.

The COMMISSIONERS thought that the current must be too strong here, and that such an embankment might prove of advantage to Inverness, Beauly, and all the adjoining ports.

Captain SHARP never went through the Caledonian Canal, but would as soon go round the Pentland Firth; and did not contemplate a great increase of trade by the present improvements on the canal, for the duty on vessels passing was to be 2*s.* per ton, and the only saving would be in insurance. He thought that improvements on the Inverness harbour were necessary, and would suggest a new dry dock and harbour, and a new entrance to the river. He would have the proposed entrance somewhat to the east of the present channel, and have a dry dock formed about the site of the present New Pier. He preferred this to deepening the present course of the river. He would add, that in case of a high east wind, a cut from the sea to the Thornbush Pier would be highly useful.

Captain LAWRENCE said there was a great want of buoys and beacons on the Moray Firth; and thought that six buoys and a large beacon were necessary between Kessock Roads and Fort George, and that they should be put down immediately. Has brought vessels into the canal by the sea-lock, but found great difficulty in doing so during a W.N.W. wind. This difficulty he thought could be obviated by a tidal basin or breakwater. Considered the basin of the canal a very great convenience. Would prefer coming through the canal when going from Glasgow to the Baltic in winter, but would rather go round the Pentland Firth in summer. In sending vessels to Liverpool, Bangor, &c., he usually sent them by the canal, as it was the shortest route. Thought improvements on the harbour and approaches were much needed, and that the merchants of the town would consent to a slight tax for this end. He thought that a straight channel from Kessock Ferry to the Thornbush Pier would be the best course for the river, and proposed that the quay should be extended there as much as the traffic required—care of course being taken to dredge the river properly for the harbour; and while the water would principally be directed into the new channel, he would leave the present bed of the river so as to enable vessels to come up by it at full tide. His reason for this change is, that as westerly winds are most prevalent here, a vessel might, in a westerly wind, sail right up to the harbour without any trouble; while in the present channel he has been kept for three days in a west wind without being able to come into harbour. In an east wind vessels can come up the present channel easily enough. He would have 10 feet in the new channel at low water.

Mr. MACTAVISH.—The Kessock Ferry quay was built in 1825-6 by Sir William Fettes. It is now the property of Colonel Baillie. It has afforded great accommodation to the ferry; but is evidently injurious to the harbour, and built on the best mooring and holding-ground belonging to

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* These buoys and beacons have since been placed.—ED.

APPENDIX C.

INVERNESS.

No. 261.
Evidence taken on the 23rd Sept. 1846, with additions.

the port of Inverness. Kessock Pier would act as a protection to the proposed new low-water pier and cut, by intercepting such mud and sand as may not be caught by the canal. He proposed an equalization of dues as a measure which would prove of much good.

JOHN PATERSON, pilot, examined.—Has been a pilot for about 15 years, and sailed in a coasting vessel for seven years before he became a pilot. Served his apprenticeship with his father, but passed no examination. There are four pilots here; two for Inverness and two for Beauly. He served as pilot to Captain Otter, R.N., and Captain Slater, R.N., during their survey of the Moray Firth, as far as Fort George. He has never known any difference in the depth of the river. There are seven warping-posts in the river, but most of them are in a decayed condition; they serve for beacons as well as for warping, and, though of use, are still very inconvenient. He thought that the channel proposed by Capt Lawrence would be very useful, but very awkward of entrance in a south wind. There are many shoals in the Firth which require buoys: the reef below Fort George wants one; Skate Bank, two; Petty Bank, two; Middle Bank, one: Meikle Mee, one; and a large conspicuous beacon at Longman Point—in all, seven and a beacon. He has known vessels get ashore on Chanonry Point from want of a light. Has often taken vessels into the Caledonian Canal. That morning he could have taken a vessel drawing eight feet water over the sill of the sea-lock at low water. Has often had great difficulty in checking vessels going into the sea-lock during a north wind, and has been obliged to drop anchor and take the vessel in stern foremost. This could be obviated by having a breakwater or tidal-basin. He stated that there is much loose mud at Clachnaharry; and has seen barges employed at the canal mouth clearing it away, but could not tell where they were emptied. There are piles of stones and a wooden jetty now erected at the mouth of the canal, which makes it much easier to take in a vessel than it was previously; but thinks an additional breakwater or tidal-basin would be highly useful.

Dr. NICOL has been a shipowner for a good many years, and he has always thought that the prosperity of the burgh depended on the improvement of the harbour, which has been most culpably neglected from want of enterprise amongst the citizens. He thought that the sum of 20,000*l.* might be raised on the harbour as a private speculation; but while they could procure a parliamentary trust, he strongly disapproved of giving the matter into the hands of a private Company. The harbour of Lossiemouth, a small but thriving seaport, a few years ago produced a revenue of about 150*l.* Since, some 3000*l.* or 4000*l.* were expended in its improvement, and it now yields a revenue of above 800*l.* A similar result, he thought, would be realized by the improvement of the Inverness harbour. The river Ness offers every inducement for improvements. The only gravel deposits were from the burn of Holm. He had been a close observer of the extent to which gravel was conveyed into the river by this burn for the last 30 years; and on some occasions he has seen immense deposits, especially at Ballafeiry, where several hundred tons were accumulated by one fresh in the river; and this was the more readily discernible, as the whole accumulations at this place had been previously carted away for the improvement of the river banks lower down.

He proposed to cut a new harbour-channel in a line with the present one at the citadel, to exclude the influence of the river entirely, and to reclaim the Carse lands of the burgh, by forming an embankment with the excavations. He considered the Thornbush Pier as inconsiderable compared with the interests of the town; but he thought it might be left as it now is, and would be a useful auxiliary to our harbour accommodation. He thought that the nearer the harbour could be brought to the burgh, the more would its real interests be improved. He dissented entirely from every proposal admitting the continued influence of the river. The harbour, if constructed on the east side of the river, and in continuation of the present new harbour, might be more expensive, but the returns would amply meet the surplus outlay.

Mr. HECTOR MORRISON, surveyor, has seen Captains Slater and Otter, R.N., on the survey of the Firth, but was not employed in watching the tides. He could furnish a plan stating the depths of water in the river, and also as influenced by the tides. He was accustomed to level; and could take levels of the bed of the river, so as to show the time the tide takes to rise from the sea upwards. There would also be no difficulty in registering the heights of the freshes.

Captain VETCH suggested that it would be better to level up the banks of the river, and to make a longitudinal section of its bed, by off-sets from these at fixed points on the banks. That five tide-scales should be erected; beginning at Kessock Pier, Thornbush Pier, New Quay, and at the New and Old Bridges, these two last serving to measure the height of the freshes or speats; the zero of all the tide-scales to be carefully adjusted to the same level as that at Kessock Ferry.

The COMMISSIONERS then expressed their satisfaction at the readiness with which the Provost, the Town Clerk, and other gentlemen, had come forward to give information; and they had no hesitation in saying that, if the inhabitants were really desirous of improving their harbour, it only remained with themselves to accomplish so desirable an object, as there can be no doubt that by the free use of the dredging-machine, the harbour of Inverness is as capable of improvement as any other in Great Britain.

(*Adjourned.*)

No. 262.

Return to Order of the House of Commons of 9th August, 1844.

No. 262.
Return to Order of the House of Commons of 9th Aug. 1844.

Inverness, March 17, 1845.

SIR,

I HAD the honour of receiving your communication of the 1st ultimo for the Harbour Return, and, having submitted that communication to the Town Council, I have received their instructions to forward the following documents, as furnishing all the information which the Council have it in their power to communicate:—

1. Printed memorial and statement for the Magistrates and Town Council respecting the harbour and shore dues of our burgh.
2. Plan of the royalty of Inverness in 1808.
3. Certified copy of report by Mr. Leslie, civil engineer, regarding pier.

I may mention in the year 1808 an Act of Parliament (48 Geo. III. c. 41) was obtained for the improvement of the harbour and other purposes, and that, after the passing of that Act, considerable sums have been from time to time expended on repairs, &c., but much remains to be done.

I have, &c.,
JAMES SUTHERLAND, *Provost.*

The Honourable H. Manners Sutton,
&c. *&c.* *&c.*

No. 263.

Memorial and Statement of the Provost of Inverness relative to the Rights of the Burgh to Shore and Anchorage Dues (*referred to in No.* 261).

No. 263. Statement of rights of the Burgh by Charter, &c.

THE Burgh of Inverness, it is well known, is one of the oldest royal burghs in Scotland. It was early favoured with grants of property, and of sundry valuable privileges, from the Scottish sovereigns. So far back as the twelfth century, the community got no less than four charters from William the Lion; and in the reign of successive monarchs they got charters confirming and extending the previous grants.

In particular, James the Sixth, by charter dated 1st January, 1591 (which is the ruling charter of the burgh), confirmed the previous rights, and, OF NEW, granted to the burgesses and community extensive properties and privileges, and, among others, "all the ports, havens, creeks, privileges, profits, commodities of the mouth of the said water of Ness, and of and in upon the said water-mouth, on both sides of the same:" "likeas, all and haill the water of Kessock, and all the landing-places on both sides of said ferry and the said water of Ness;"—"with all and every one of the burgal farms and petty customs of the said burgh of Inverness, and of all towns, cities, villages, market-places, and streets, within our sheriffdom of Inverness, and especially the colleges of the burgh of Tain, Ross, Merkinch, Chanery, Dornoch, Thurso, and Wick, in Caitness, to be intromitted, levied, received, gathered, and applied to the public use and good of our said burgh of Inverness; and likewise with liberty and privilege to our burgh of Inverness, and to the provost, bailies, councillors, burgesses, and community thereof, and their successors, that no ship, boat, barque, or vessel, sailing betwixt the Tarbatness, with wine, salt, fish, timber, and other merchandise, ought to be disburdened or break bulk till it come to our said burgh of Inverness, and there may be exhonored and break bulk as to the first and principal burgh of our said sheriffdom of Inverness"—"and with all customs, anchorage, and commodities of the foresaid ports and havens, and with all and sundry the farm-dues, customs, tolls, profits, commodities, and other things foresaid, we, by these presents, give, grant, and for us and our successors perpetually confirm, to our foresaid provost, bailies, counsellors, and community of our said burgh of Inverness, and their successors forever, to the upholding, repairing, and decoring of our said burgh, of the bridge, and other common works of the same."

The above charter was ratified and confirmed by Parliament, as will be seen from various ratifications granted during the reigns of Charles I. and Charles II. It was also ratified by an Act of the Parliament of James VII., in 1685, whereby the "anchorage," "havens, ports, bulwarks," are specially enumerated, together with all "customs, duties, stents, and impositions of the same."

The right of exacting shore and anchorage dues, conferred by those grants, was very important, and extended, it will be seen, not only over the ports in the immediate vicinity of the burgh, but to Tain and other places—embraced of old within the limits of the sheriffdom of Inverness. It is now not well known when, or how, the burgh of Inverness lost or conveyed their right to the shore and other dues exigible by them in the ports of Tain, Chanonry, Rosemarkie, and other ports within the ancient sheriffdom; but the records of the town establish that, for time past memory of man, the magistrates and council exercised the right of exacting those dues for all ships moored or anchored, and all goods shipped or landed, within what has been always known as the *Port of Inverness*—including Kessock Roads, the west side of the mouth of the river, with Abban and *Merkinch*, and to the east, seaward, as far as the burn of Screetan Graat, below Culloden. The lands of Merkinch, at one time, and until comparatively a recent period, formed an island in the mouth of the river Ness, one branch of which ran on the west of these lands, through Abban, and joined the sea near Clachnaharry—the other branch running in the present channel on the east. In the locality called Abban, where the western branch of the river formerly flowed, the canal basin, to be afterwards more particularly noticed, has been partly formed, and is consequently within the ancient port of Inverness.

Tables of the shore and anchorage dues were, from time to time, framed, passed, and recorded by the council. The right of collecting them was almost uniformly let to tacksmen, who paid the town slump sums in name of rent, and who, like the magistrates and council when they made the collections themselves, regularly and uninterruptedly exacted the dues within the limits above specified.

Shore-dues were exigible, and exacted, for all sea-borne goods of every description landed in the vicinity of the town, and brought in to it by merchants and other traders; the burgesses and freemen of the burgh being only liable to pay one-half of the sums payable by unfreemen and strangers. No objection was made to the payment; and there was no other place in the vicinity of the town where commodities coming to and going from it could be conveniently shipped or unshipped, except within the limits of the Port of Inverness, as now described.

In the year 1822, however, the navigation of the Caledonian Canal was opened from sea to sea. By the Canal Acts, passed in the years 1803 and 1804, the Commissioners were authorised to construct a harbour or basin, where it has since been constructed, in the immediate vicinity of the lands of Merkinch. They also constructed certain wharfs for the accommodation of vessels when shipping and landing goods. The canal basin is thus founded on the wester side of one of the outlets of the river, and the entrance to it is from Kessock Roads, within the territory of the town. The canal basin, at least a considerable portion of it, is clearly within the limits described in the charter as the "mouth of the river, Kessock, and ports, havens, creeks, and landing-places" on both sides of the river, and the whole basin, with all the wharfs in its vicinity, for steam-vessels and others, are within the parliamentary boundaries of the burgh.

After the canal was opened, and more particularly within the last few years, not only the steamboats and other vessels coming from the *west* with goods for Inverness land these goods at the canal-wharfs in the neighbourhood of the basin, but vessels coming from the east, by the Moray Frith, instead of entering the river, or anchoring at Kessock Roads, go into the canal and discharge and receive cargoes at a quay formed on the east side of its basin, within a few yards of the once insulated Merkinch, and the goods there landed, at least the greater portion of them, are immediately brought into the town, the export cargoes being brought from the burgh and surrounding district.

The memorialists believe it to be universally allowed that harbours like that of Inverness have a certain extent of adjacent shore within the limits of which all goods landed or shipped are subject to the same dues as if landed or shipped at the piers; and the reasonableness of this is obvious, because, were the case otherwise, private speculation would, in many instances, destroy the public sources of revenue, and consequently all inducement to improve and maintain such harbours at the public expense.

Under such circumstances, two questions arise:—

No. 263.
Statement of rights of the Burgh by Charter, &c.

1st, Whether, without reference to the provisions of the Canal Acts, the town would be entitled to exact dues for goods landed and shipped at the canal basin? and

2nd, Whether the provisions of these Acts exclude the right?

I. It is apprehended that, at all events in so far as regards commodities sent from or brought into the burgh by sea, and shipped or unshipped at the canal basin, the town authorities are entitled to dues, particularly to such dues as were exigible under the old charters and rights of the burgh. The town of Inverness, besides large sums expended in former times for the construction of a harbour, have, within the last thirty years, laid out no less than about 6000*l.* on harbour improvements—a sum which now forms the principal part of the debt of the burgh, and which the magistrates would not have been justified in expending, could they have the slightest conception that the public money would have been applied in such a manner as to deprive them directly or indirectly of their ancient chartered rights, dues and revenues. The town having thus expended considerable sums on the harbour and its piers, and the maintenance and extension of the accommodation to shipping afforded by the port, being indispensably necessary, it is thought that no court of law would sanction the evasion of the town's rights, by vessels entering the canal for the purpose of receiving goods from the town, and discharging others destined for its trade and commerce. Let it be constantly kept in view that the canal basin is partly within the precincts of the port of Inverness, and the whole of it is in the immediate vicinity of that port, while all the goods landed at the canal basin wharf, or nearly all of them, are brought into the burgh for the purpose of being disposed of, in the same way as goods landed at the burgh quays.

Now, the memorialists are advised that no wharfs or landing accommodations could have legally been erected in such a locality by any private party in prejudice to the burgh privileges, and that the use of the canal wharfs cannot deprive the community of their chartered and immemorial rights of exacting dues on all *sea-borne* goods landed and brought into town for the purposes of traffic, unless exempted by special authority.

It is true that the canal statutes authorise the exaction of certain dues from the parties using the accommodation thereby afforded; but these dues are not of the nature of shore and anchorage dues, and neither the canal nor its basin was formed with the view of being used as a harbour for the burgh of Inverness, whose privileges were certainly not intended to be interfered with or diminished by the Canal Acts.

II. This leads the memorialists to consider, in the *second* place, whether the canal statutes have, either expressly or by implication, destroyed any of the burgh rights.

By section 50 of the Act 44 Geo. III. cap. 62, it is provided, "that all persons whatsoever shall have free liberty to use with horses, cattle, and carriages, the roadways and passages, except the towing-paths, to be made by virtue of this Act, for the purpose *of conveying* any timber, goods, ware, merchandise, and other things to and from the said navigation, and every part thereof, without paying anything for the use of such roads, ways, and passages, and also to navigate and pass upon and use the said navigation with any ships or vessels, boats, barques, or other craft, and to employ the said wharfs and quays for loading and unloading such merchandise, timber, and other goods and things; and also to use the said towing-paths with horses and other cattle, for haling and drawing such ships, boats, barques, or other craft, upon payment of such rates as shall be demanded by the said Commissioners, or any person appointed by them for that purpose, not exceeding the respective sums herein mentioned, and subject to the rules and regulations which shall be from time to time made by the said Commissioners, by virtue of the powers herein granted."

Now, with reference to this clause, and when considering the extent to which it may affect the rights of a third party, it is proper to attend to two things—

1st. The object which the Legislature had in view in making the canal; and

2nd. The clear and unambiguous terms of the acts themselves regarding the rights and interests of others, whether corporate or private parties.

In the *first place*, the idea cannot for a moment be entertained, that the canal was made, or any part of the expense attending it incurred, for the purpose of establishing a rival harbour to supply the accommodation previously afforded, and still capable of being afforded, by the Burgh harbour. The whole tenor of the Act excludes such an idea. The preamble of the original Act bears, that the parliamentary grant was made "towards forming an inland navigation from the eastern to the western sea by or near Inverness and Fort William, which navigation, when completed, will enable ships and vessels of considerable burden, trading between the eastern and western coasts of Great Britain and Ireland and the German Ocean, *to avoid a dangerous navigation round the northern coasts of Scotland.*" From one end of the Act to the other not a hint is to be found that the harbour of Inverness was insufficient for the accommodation of the district. The canal undertaking was originated and completed *for the purposes* announced in the statute, and not for the purpose of supplanting the harbour of Inverness, and thereby depriving the burgh of its accustomed and necessary revenues.

In the *second place*, the Acts contained the most ample and comprehensive provisions for compensating such parties as might suffer loss by the canal operations. Section 27 enacts, that "all and every body or bodies politic, trustees, or other persons herein before entitled to sell or convey lands, tenements, or other heritages, or any other owner or owners, and the occupiers of any lands, tenements, or other heritages, through, in, or upon which the said navigation, towing-paths, quays, or other works hereby authorised, are intended to be made, or of any mills or other works from which any water to supply the said navigation may or shall be taken or diverted, may and shall accept and receive satisfaction for the value of such lands, grounds, tenements, &c."

The statute contains no provision for compensation of any other kind whatever, and it is solely in virtue of the clause just quoted that any claim of recompence could be maintained for injury done to property.

The memorialists consider it clear that the clause referred to would not sanction or support a claim at the instance of the Magistrates and Council of Inverness for injury done to their right of shore-dues. Such rights do not seem to fall within the intendment or spirit of the Acts. They are not expressly condescended on, nor can it be held that they are embraced by implication.

Upon the whole, then, and as the Acts clearly and anxiously provide for reparation for damages and injury done to property, and do not contemplate or sanction compensation for injury occasioned to the rights of shore dues competent to the town of Inverness, the reasonable and unavoidable conclusion to be arrived at, is, that these rights cannot, to any extent, be held as extinguished by the Acts, and

APPENDIX C.

INVERNESS.

No. 263.
Statement of rights of the Burgh by Charter, &c.

that, notwithstanding the terms of section 30, above quoted, these rights, if in the circumstances they extend to the canal-basin, still exist.

There is yet no prescription. The Canal Acts announced no intention to make a harbour at the basin, in opposition to the rights and privileges of the town; and no intimation was given of any such intention, nor was it until after the work was completed that shipowners began to see that by loading and unloading in the canal they might evade payment of the dues of the town.

The memorialists, while they acknowledge the importance of the canal to the public generally, would respecfully submit that the Commissioners are in justice bound, now that the subject is thus brought before them, to prevent future injury to the town, and the object in view could very easily be effected by a regulation directing the canal officers to recognise the right of the town to exact their customary shore-dues for all goods coming to or passing from the burgh of Inverness by the canal-basin and adjacent piers within the parliamentary boundaries of the burgh.

JAMES SUTHERLAND, *Provost of Inverness.*

No. 264.

Report by WILLIAM LESLIE, Esq., C. E., *on the proposed Steam-boat Pier at Inverness, and Estimate.*

No. 264.
Leslie, on the proposed Steam-boat Pier, and Estimate.

Aberdeen, December 5, 1834.

AGREEABLY to the desire of several gentlemen connected with the steam-boat navigation to Inverness, upon the 25th of November current, I examined Kessock ferry and the places adjoining, with a view to ascertain the most proper situation for erecting a pier to which the steamer could approach at all states of the tide.

The two most eligible situations are near the ferry-pier,—the one about 180 feet eastward, and the other about 410 feet westward from it, near the site of the old boat-pier. The length of the one on the east side, from the bank at high-water mark until it reaches a depth of 7 feet 6 inches of water or thereby at the lowest state of stream-tides, would be about 310 feet, the beach sloping in nearly an inclined plane the whole way.

It has been objected that if a pier were carried out at this place, it would be greatly in the way of the ferry-boats, as they are often by strong westerly winds carried eastward, and have to be hauled up the beach to windward under the lee of the ferry-pier. I consider that it would obviate this objection (if it should be considered of consequence) to have a rope fixed at one end to the ferry-pier, and the other to a buoy anchored near the end of the new pier, by which the boats could pull up to windward any time it was found necessary.

If the pier were to be erected at the western position, an embanked roadway would be required to connect it with the road at the ferry-pier, 410 feet long, 18 feet broad at top, and about 6 feet high, with slopes of 1½ feet horizontal to 1 foot of perpendicular height, pitched on the sides to resist the action of the sea. From the termination of the roadway, about 70 feet westward of a pile of wood on the beach, the length of the pier, till it reached an equal depth of water as proposed at the eastern side, would be 254 feet, or 56 feet shorter than the other. This place would be out of the way of the ferry-boats, as they say they are scarcely ever driven westward, and the water increases more rapidly in depth beyond the places where the piers would terminate at the western than at the eastern side. I likewise took a view of the mound at the eastern bank of the Caledonian Canal, and, although I did not particularly examine it, I see from the few soundings I took that there would be but little expense saved by erecting it there; besides, I learn that there are sandbanks outside, where there is less depth of water than at a short distance from the end of the mound, which would, I apprehend, be very inconvenient for vessels while coming up to the pier at low water; and it should be borne in mind, that, although there might be a little saving of expense at first in erecting the pier, yet the distance from the town, the consequent expense of land-carriage, and making a road along the canal-bank, would more than balance all the saving.

I am of of opinion that the position to the eastward of the ferry-pier would be the more eligible one on account of its adjacency to the town and ferry, and to the public road; it is also much sheltered from the westerly gales by the ferry-pier and the point of land above it; and the tides, which are here very strong, run chiefly on the opposite side: and I doubt not but that the dues which would be derived from the steamer, goods, and passengers, and by the smacks which might occasionally take advantage of the pier, would fully compensate for the first outlay.

The enclosed plan will show the nature and appearance of the framings of the pier. From the limited time I had on the spot, and the state of the tides at the time, it was impossible for me to take the measures and soundings (actually) exactly, but those taken and laid down on the plan are, I apprehend, sufficiently accurate to enable the gentlemen concerned to decide on which of the places they would give the preference to.

The breadth of the roadway is 7 feet between the rails, which is the least that it could be to allow carts or carriages to be shipped or landed by it. The length of the head is 24 feet, the breadth 16 feet, well secured with piles and stays.

I have proposed part, at the end next the land, to be of stone. If I knew the expense of stone from Redcastle I would probably advise more of it to be made in that manner; but this can be ascertained before all the details of the plan are agreed upon.

In the annexed estimate I have calculated on the best Memel timber being used, and also on the most approved methods being taking for protecting the timber against the attacks of the gribble-worm.

Probable expense of erecting a pier at the eastern side of the ferry-pier, agreeable to the plan No. 1 is, as under:—

	£.	s.	d.
Stone embankment, land end	30	0	0
Roadway of pier, 244 feet long	412	0	0
Outer head	269	12	10
	711	12	10
Add 5 per cent. for incidents	35	10	2
Total	£747	3	0

Appendix C.

Inverness.

No. 264.
Leslie, on the proposed Steam-boat Pier, and Estimate.

At western position, according to plan No. 2:—

Embanking roadway to Ferry Pier	88	15	6
Stone embankment, land end	35	13	4
Roadway of pier, 193 feet long	329	10	0
Outer head	269	12	10
	723	11	8
Add 5 per cent. for incidents	36	1	10
Total	£759	13	6

William Leslie.

No. 265.

Opinion of Counsel as to the Right of the Authorities of the Burgh to levy Dues within limits granted by Charter.

No. 265.
Opinion of Counsel as to the right of the Burgh to levy Dues within certain limits.

1. Having regard to the plan of the locality shown to us at the consultation, we are of opinion that the canal-basin is within the limits of the grants of port and harbour made to the burgh of Inverness by the charters referred to in the case; and that, supposing the right not to be excluded by the provisions of the Canal Acts, the town would be entitled to exact dues for goods landed and shipped at the basin.—Magistrates of Edinburgh *v.* Scott, 14 S. & D. 922; Magistrates of Campbelltown *v.* Galbraith, 7 Bell and Murray, p. 220.

2. Assuming the canal-basin to be within the limits of the grant, we are of opinion that the provisions of the Canal Acts would not exclude the right of the burgh to the dues in question; we think that, on a sound construction of these Acts, the provisions empowering the public to use the basins, wharfs, &c., of the works, on payment of the dues authorised to be exacted by the Commissioners, apply only to the right as between the Commissioners and the public, and that these provisions were not intended to take away, and did not in effect take away, the rights of the burgh of Inverness to any dues to which they might otherwise be entitled in respect of goods shipped or landed within the limits of their grants.

Fitzroy Kelly.
Jas. Anderson.

London, June 3, 1846.

No. 266.

Report of the Admiralty Surveying Officers, David Stevenson, Esq., C.E., *and* Joseph Maynard, Esq., Commander R.N., *on the proposed Improvements in the Harbour.*

No. 266.
Stevenson and Maynard, on proposed Improvements.

Edinburgh, March 9, 1847.

In compliance with the commands of the Lords Commissioners of the Admiralty, we have instituted the necessary investigations as to the powers sought by the promoters of the improvement of the harbour and navigation of the river Ness in the proposed Bill now before Parliament.

After duly advertising the time and place of meeting in terms of the Act 9 and 10 Vict. c. 106, which accompanied their Lordships' instructions, we met with the parties at Inverness on the 24th, 25th, 26th, and 27th ult., on which occasions we heard statements and received oral and documentary evidence in support of, and in opposition to, the proposed measure. We also carefully inspected the locality in question, and took such other steps as we thought necessary in order fully to acquaint ourselves with all the circumstances of the case; and having given the whole subject laid before us due consideration, we have now to submit the following Report:—

The arguments urged against the scheme of improvement and provisions of the Act contemplated by the promoters of the Bill are numerous, and embrace a great variety of topics. The following appear, however, to be the chief objections:—1st. That the amount of capital to be expended, and the extent of the proposed works, exceed the means at disposal, and are far beyond the wants of the port; more especially as the basin of the Caledonian Canal, which is equally near the town, and commands a depth of 7 feet at low-water, is opened to the trade of Inverness, and has of late been extended mainly with a view to the accommodation of the local trade of the district. 2nd. That the permanence of the works proposed is improbable, and their success, if permanent, doubtful. 3rd. That they will materially injure the salmon-fishings of the Ness. 4th. That in those provisions of the Bill which regulate certain payments to be made to the burgh of Inverness, an amount of debt has been erroneously assumed as being chargeable against the harbour, which, if remitted, would afford considerable funds for carrying out improvement without applying to Parliament at all. And lastly, That the dues proposed to be levied are not fairly imposed on the inhabitants.

On all of these points we heard statements and evidence, for the details of which we have respectfully to refer their Lordships to the Minutes of Proceedings, which have been carefully prepared and will be transmitted if required. In the present Report, however, we have considered it unnecessary to do more than simply to enumerate these objections without entering on the merits of the arguments adduced by the one side or opposed by the other, as our investigations have irresistibly led to the conclusion that neither party has brought to bear upon the subject a sound knowledge of the actual source of the difficulty which at present attends the navigation of the Ness, or suggested a proposal adequate to its amelioration or removal.

With the exception of clearing away some stones which impeded the navigation, no works have been executed for the improvement of the Ness. Even in its present natural state, however, there is a depth of 17 feet at high-water of ordinary spring-tides up to the Thornbush pier, and, excepting at a single inconsiderable shoal, there are not less than 14 feet up to the quays of Inverness. The harbour is close to deep water at Kessock Ferry, the whole distance up to Inverness being under a mile, and the course of the river is not inconveniently tortuous.

The entrance to the harbour is sheltered from all heavy seas, and is not interrupted by any bar or

No. 266.
Stevenson and Maynard, on proposed Improvements.

shifting sandbanks, and the roadstead of Kessock is in the immediate vicinity. With all these advantages, however, the evidence on both sides went to prove that the harbour is difficult of access, that vessels can seldom or never come to the Thornbush pier without being tracked by horses or men (amounting sometimes to 30 or 40 in number)—a process which not only occasions considerable expense, but sometimes is attended with great delay and even damage to the vessels. Even at the period of our visit, at which time the weather was exceedingly fine and the river in a tranquil and low state, we had an opportunity personally of witnessing this inconvenient and tedious system. The promoters of the measure led evidence at great length to prove that the direction of the prevailing winds was directly down the sea-reach of the river, and attributed the difficulty attending the navigation to this circumstance, which they propose to remedy by cutting a new channel.

Their views of the case are thus described in the evidence of Mr. Leslie, the engineer:—"The present channel," he says, "is difficult to navigate. The outer part of it points north-east and south-west, and the south-westerly are by far the most prevalent winds. It is difficult for vessels in such winds to work up the channel. I consider that vessels will work up the new channel much more easily. It points nearly north and south by compass. South winds do not prevail so much as south-west winds, and therefore vessels will work up more easily, in addition that the channel is shortened considerably (100 yards), and being nearer the land, should towing be required, a much shorter tow-rope will suffice." This quotation represents the difficulties which the promoters stated to the navigation of the Ness, and expresses the views on which the proposed improvements have been based. But our investigations have led us to conclude that any works constructed in terms of such views would not be found to accomplish the desired effect. It is in our opinion not to the prevailing winds, but mainly to the prevailing currents due to the physical formation of the bed of the Ness, that the difficulty of navigation is to be traced. It seems impossible, in fact, with all the advantages possessed by the harbour, to account for the difficulty attending the navigation in any other way; and unless these currents are rendered subservient to the purposes of navigation by sufficiently extensive and properly directed works, we cannot anticipate any practical improvement on the present access, or any benefit to the trade of Inverness, which would justify the expenditure contemplated under the proposed Bill.

In order to explain our views more fully, it is only necessary to direct the attention of their Lordships to the following facts regarding the tidal phenomena and formation of the channel of the Ness, as stated in evidence.

1st. The rise of ordinary spring tides at the mouth of the river is 14 feet.

2nd. The distance to which the influence of such tides extends is only about 2 miles, which includes the whole tidal compartment of the river.

3rd. The slope or inclination of the low-water line of this tidal compartment is no less than 7 feet per mile, and the tides take from 2 to 3 hours to make their way up the first mile. And,

4th. The natural result of such a state of matters is that the surface or fresh-water current greatly predominates over that of the tide, and consequently the phenomenon of a current due to flood-tide may be said to be almost unknown.

Under these circumstances therefore it appears evident to us, that the natural barrier which at present exists to the free navigation of the river is the absence of a tidal current or indraught to assist the entrance of vessels from Kessock Roads, and their farther progress to the quays, which they are at present forced to effect by help of men and horses, against the constant current of ebb, which varies in intensity with the state of the fresh-water stream, and is produced by the steepness of bed and contracted extent of the tidal capacity of the river, which do not admit of a current being generated at the mouth, and propagated up the harbour. The practical effect of this on the navigation it is almost unnecessary to enlarge on, but it is sufficient in our opinion to cause all the difficulties experienced, and to account for the opinions expressed by some of the seafaring witnesses, "That the most tedious and harassing part of their voyage was invariably that of entering and tracking up the Ness to Thornbush quay."

The operation which would chiefly tend to reduce the velocity of the present ebb (if carried out to a sufficient extent to establish a current of flood, and thus facilitate the navigation) is the reduction of the low-water slope of the river by excavating the bed from its mouth upwards. That great improvement could in this way be produced by the free use of dredging, and that this is in fact the only means by which satisfactory improvement could be effected, we are perfectly prepared to state, but we are not possessed of sufficient data to enable us to judge how far this operation would require to be carried in order to produce such an improvement as would satisfy the present or prospective wants of the trade, nor to form an opinion as to whether or not it would be more expedient to enter upon such a work or to overcome the natural difficulties attending the navigation by the constant use of a steam-tug.

It may perhaps be proper for us to remark, that the scheme of improvement proposed by the promoter (that is, of making a nearly straight cut from Thornbush quay to the sea, and blocking up the present channel), even although it were calculated to effect the object in view, is in our opinion open to serious objections, particularly as regards the doubt which we have of its being possible to maintain in its altered position the proposed new cut, the entrance to which we are strongly of opinion would be gradually moved towards the east by the strong ebb current of the Kessock Roads, until it again resumed its present course. As however we do not concur in the first principles upon which the contemplated improvements have been projected, it is perhaps unnecessary for us to offer further remark on the other details of the proposed work, and we shall therefore conclude our report by expressing our opinion that a satisfactory improvement on the harbour at at Inverness can only be effected—1st, by regulating the currents of the existing navigation; or, 2ndly, in the event of that being found inexpedient from expense or other causes, by establishing quays and docks at Kessock, altogether independent of the river; or, 3rdly, by the establishment and maintenance of an efficient system of steam-tugging. The projected scheme does not seem to contemplate or comprehend either of these alterations, but, on the contrary, the formation of the new cut will tend, by shortening the course of the river, to increase the rapidity of the ebb current, and will otherwise fail in giving the desired facility to navigation; and we are therefore respectfully of opinion, that the measure in its present form ought not to receive the sanction of the Lords of the Admiralty.

DAVID STEVENSON.
JOSEPH MAYNARD, *Commander R.N.*

No. 267.

[Admiralty Report on the Inverness Harbour and Navigation Improvement Bill.

No. 267. Admiralty Report, on the Harbour and Navigation Improvement Bill.

Admiralty, March 20, 1847.

THE main scope of the Bill is to create a distinct trust for the management of the harbour and its funds, by separating it from the general municipal government, and vesting it in seventeen trustees, seven of whom are to be so *ex officio*, as members of the Town Council, and the other ten to be elected directly for the office.

The Bill consists of 114 clauses, regulating the qualifications of the trustees and their electors, and providing a code of harbour government and revenue, all drawn up with much care and judgment, for the faithful and prudent working of the trust.

The Bill authorises 25,000*l.* to be raised by a loan on the revenue of the harbour, for its improvement.

Clauses 44, 45, 48, and 69, refer in part to particular works designed for the improvement of the harbour, and it is in respect to these works that the jurisdiction of the Admiralty particularly applies.

The works proposed consist principally of a diversion of the channel of the river Ness, by giving it a straight course for the last half-mile, where it discharges itself into the Moray Frith.

Their Lordships are of opinion that the object in view by the diversion of the bed of the river would not be so obtained, and that the evils would rather be increased than otherwise; that there would be no certainty that the new channel would be rendered permanent in its position; and that much evil, instead of benefit, might arise from the measure, if carried into execution.

The present channel of the river from the town of Inverness to the Moray Frith is composed of gentle and easy curves; the mouth is without any bar, and the bed is of gravel, easily to be dredged, and all that appears safe and useful to be done is a free use of the dredging machine, for deepening and improving the present bed for the river, and for giving as much space for the influx of the tides as practicable.

Assent will therefore be given to the Bill on the condition that portions of certain clauses which apply to works for the diversion of the channel of the river Ness be so modified as to exclude that measure; but assent will be given to the improvement of the river by widening and deepening the channel, and by rounding off any turns which appear too sudden, but without disturbing the general course of the river as now existing.

H. G. WARD.

No. 268.

Return of the Income and Expenditure for the Years 1842-3-4.

No. 268. Income and Expenditure.

INCOME.				EXPENDITURE.			
Heads of Income.	1842	1843	1844	Heads of Expenditure.	1842	1843	1844
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Rent of anchorage and shore dues, as paid by lessee .	755 0 0	835 0 0	845 0 0	Salary of harbour-master	15 0 0	15 0 0	15 0 0
				Repairs and improvements of harbour .	14 11 5	..	125 11 9
				For new Act of Parliament . . .	..	..	107 12 3
				Total	29 11 5	15 0 0	248 4 0

Dues levied by Royal Charter, and Act 48 Geo. III., c. 41.

JAMES SUTHERLAND, *Provost.*

Debt said to be due to the Corporation in 1846, about 4000*l.*

CROMARTY.

CROMARTY.

No. 269.

Return to Order of the House of Commons of August 9, 1844.

No. 269. Return to Order of the House of Commons of 9th Aug. 1844.

Cromarty, Feb. 18, 1845.

IN obedience to the Resolution of the House of Commons, of date the 9th day of August, 1844, and relative Order, respecting the harbours and havens in the United Kingdom, the trustees of the harbour and port of Cromarty respectfully beg leave to make the following return:—

1st. The trustees, acting in and for the port and harbour of Cromarty, are specially nominated and appointed by Act of Parliament passed in the fourth year of the reign of his late Majesty King William the Fourth, entitled "An Act for preserving and maintaining the Piers and Harbour of Cromarty," in virtue of which they have acted and now act.

2nd. The trustees transmit herewith a copy of the plan of the harbour of Cromarty, taken a few years ago.

3rd. The trustees have no report by "engineers or other officers respecting this port or harbour;" but they understand it was inspected by engineers, under the direction of Government, in the year 1804, with the view, it is said, of erecting certain works or fortifications for its improvement and defence, and a report made by them thereon to the Secretary of State; and about three years ago a similar report was made by Lieutenant Slater, R. N., Admiralty Surveyor.

4th. The trustees hold no written complaints of the harbour and port under their charge; indeed not an instance of shipwreck has taken place in this bay in the memory of man; although it has been frequently recommended and urged to get this port erected into a harbour of refuge, for which it is well adapted, seeing that so vast a number of vessels take shelter there from storms and gales of wind, which render any port on the east coast of Scotland, south and north, unapproachable; and the trustees with that view have recently memorialised the Commissioners for the Forfeited Estates in Scotland on the subject.

APPENDIX C.

CROMARTY.

No. 269.
Return to Order of the House of Commons of 9th Aug., 1844.

5th. This port and its roadsteads, which are the largest and safest, as well as the easiest of access, of any in Great Britain, are unprotected by any defence or fortification, which, from its position and natural advantages, might, in a national point of view, be advantageously erected at a comparatively trifling expense, and, in the event of foreign aggression, would become absolutely necessary for the protection of the shipping taking shelter in this bay, frequently from 50 to 70 sail at a time, and in the course of the year from 600 to 800, as well as for the protection of the general trade of the Firth, and of the Channel leading from the Moray Frith to the port, roadsteads, and bay.

All which is humbly reported by

GEORGE M'DONALD,
For Self and the other Trustees.

Hon. H. Manners Sutton.

No. 270.
Income and Expenditure.

No. 270.

Return of Income and Expenditure for the Years 1841–2–3.

INCOME.				EXPENDITURE.			
Heads of Income.	1841	1842	1843	Heads of Expenditure.	1841	1842	1843
	£. s. d.	£ s. d.	£ s. d.		£. s. d.	£. s. d.	£. s. d.
Rent of harbour dues	65 0 0	65 0 0	63 0 0	Expenses of the trust	14 15 0	14 18 0	15 12 6
				Repairs of harbour .	..	1 0 0	10 5 4
				Total . £	14 15 0	15 18 0	25 17 10

Dues levied under the authority of the Act, 16 June, 1834.

G. M'DONALD, *Provost of Cromarty, and one of the Harbour Trustees.*

PORTMAHOMACK.

No. 271.
Return to Address of the House of Commons of 29th July, 1844.

PORTMAHOMACK.

No. 271.

Return to Address of the House of Commons of July 29, 1844.

December 16, 1844.

	May 15, 1842.	1843	1844.
Total Revenue	£35 0 0	£35 0 0	£35 0 0
Expenditure for clearing harbour	..	..	7 0 0

The revenue consists of dues on goods, grain, &c., which are levied under Act of Parliament.

CRAWFORD ROSS.

Hon. H. Manners Sutton.

LITTLE FERRY.

No. 272.
Return to Order of the House of Commons of 9th Aug. 1844.

LITTLE FERRY.

No. 272.

Return to Order of the House of Commons of 9th August, 1844.

April 24, 1845.

THERE is no Act of Parliament for this harbour, and no maps or reports to be had regarding it.

The pier or jetty on the north side is sufficient, and quite convenient for the trade; but much inconvenience and expense are occasioned by the want of a similar erection on the south side, which prevents vessels from being either loaded or discharged, except by tide-work.

Pier erected at the expense of the Duke of Sutherland.

GEO. GUNN.

Hon. H. Manners Sutton.

No. 273.
Income and Expenditure.

No. 273.

Return of Income and Expenditure for the Years 1841–2-3.

INCOME.				EXPENDITURE.			
Heads of Income.	1841	1842	1843	Heads of Expenditure.	1841	1842	1843
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Tonnage dues . .	12 8 4	13 0 4	16 6 8½	Salary for collecting dues.	6 0 0	6 0 0	6 0 0
Export and import dues	34 8 5	33 8 5	38 8 9½	Materials for and repairs of harbour, &c.	39 11 10	29 15 5	29 1 0
Total . £	46 16 9	46 8 9	54 15 6	Total . £	45 11 10	35 15 5	35 1 0

Dues levied by consent. No Act.

GEO. GUNN.

BRORA.

BRORA.

No. 274.
Return to Order of the House of Commons of 9th Aug. 1844.

No. 274.

Return to Order of the House of Commons of 9th *August*, 1844.

April 24, 1845.

No Act exists for this harbour, nor are any maps or reports to be had regarding it.

At various times accidents have occurred from the shifting of the bar and the rough state of the river entrance, by deposits of rocks and stones at its mouth; but except the clearing of the channel and mud from the harbour, nothing appears to be required for the accommodation of the trade of the port. No dues are levied. Harbour maintained at the expense of the Duke of Sutherland.

GEO. GUNN.

Hon. H. Manners Sutton.

No. 275.

Remarks on Leck Roby.

No 273.
Remarks on Leck Roby.

Leck Roby, April 24, 1845.

IF the present inquiry has for its object not only the improvement of harbours generally, but also the construction of harbours of refuge, there is perhaps no situation for such a harbour as Leck Roby on the whole of the east coast of Scotland. At this point, which lies a little westward of the river Brora, there is a ledge of rock running into the sea, which appears by nature to have been intended for the erection of such a work, being perpendicular on the west or inland side, of considerable breadth on the top, and sloping seaward so as to form a natural protection to any erection that may made upon it. On the west side lies a bay of sufficient extent, with a good bottom; and the depth of water, it is believed, would be sufficient for a ship of the line to enter at low water; and having no bar outside, and possessing so great a depth of water, no breakers are at any time to be seen.

Independent of the general protection which such a harbour would afford to shipping generally, in distress, and more especially when it is considered that upon the opening of the Caledonian Canal, the passage of the Moray Firth will be frequented by ships of a *large* class (for it cannot be doubted that Cromarty, however safe when gained, is even on many occasions frequently beyond the reach of coasting vessels in thick weather). This harbour, if executed, would be the resort during the fishing season, of herring curers, who, from access being had at all states of tide, would find it a most eligible resort for prosecuting this important branch of industry.

GEORGE GUNN.

HELMSDALE.

HELMSDALE.

No. 276.
Return to Order of the House of Commons of 9th Aug. 1844.

No. 276.

Return to Order of the House of Commons of August 9, 1844.

April 24, 1845.

"AN Act to repair and maintain the Harbour of Helmsdale and Works connected therewith, in the Parish of Loth and County of Sutherland." (Royal Assent 23rd May, 1828).

The only maps to be got are—

1st. The map attached to Mr. Loch's book.
2nd. The map referred to in the Act of Parliament and attached to it.
3rd. The map prepared by Mr. Leslie in 1839, and report thereon; which embrace the improvement of the harbour in every point of view of which it was considered capable.

All that has been executed of this last plan was the wharf or breast wall, running from the bridge, on the north side, and terminating in the "proposed pier," the partial turning of said "pier-head," and the breakwater running downward from the same; for which Mr. Leslie was paid, in 1841, 783*l*. 15*s*.

No complaints have been made but verbally, in reference to this harbour, since the last improvement above stated was executed, and these apply—

1st. To the want of accommodation for vessels and boats during the rapidly increasing herring-fishing.
2nd. To the want of protection to vessels lying in the harbour during gales from E. and N.E., as, from want of water in the "proposed harbour," or upper basin, they are exposed to the run of the sea at the lower wharf.
3rd. The trade are frequently subjected to loss, and vessels endangered, by the shifting of the bar, caused by a long prevalence of either easterly or westerly winds. Harbour and works maintained at the expense of the Duke of Sutherland.

GEO. GUNN.

Hon. H. Manners Sutton.

No. 277.

Report by WILLIAM LESLIE,Esq., *on the Damage to the Harbour by Land Floods, the best means for remedying it and improving the Harbour, and Estimate.*

No. 277.
Leslie, on improving the Harbour.

SIR,

Aberdeen, December 27, 1839.

IN conformity with your instructions I, upon the 13th and 14th of November, examined the harbour of Helmsdale, for the purpose of ascertaining the damage done to it during the late flood in the river, the best mode of repairing it, and at the same time of increasing the accommodation in the harbour.

Keeping these objects in view, I inspected the harbour, took what measures and levels I thought

Appendix C.

Helmsdale

No. 277.
Leslie, on improving the Harbour.

necessary, have since carefully to the best of my ability considered the subject, and now beg to hand you a plan of the harbour, showing the alterations I propose, and to which it will be necessary frequently to refer, and to report as follows:—

I found that the river during the flood had broken over the gravel bank at the upper end of the harbour, and carried a considerable part of it, and likewise a quantity of gravel brought from the higher ground, and lodged the whole in the basin, banking it up chiefly at the lower angle of the harbour on the section A B, where the gravel is nearly as high as the quay-walls; there is likewise a large quantity laid over the bottom of the harbour, which has reduced the depth of water considerably; the river had also undermined and thrown down the jetty, which ran up from the lower pier into the basin, with a portion of the quay-walls on either side adjoining it, and also cut away the foundation, of about 50 feet long, of the lower pier-wall at R, which has caused the wall to sink considerably, although it has not yet fallen; and, during the same flood, had carried away the facing of stone which was on the east bank of the river below the bridge, and cut away part of the ground behind it.

Such being the case, the first thing to be done would be to remove the gravel from the bottom of the harbour, to allow vessels to get access to the quay-walls, but, as the accommodation is too limited for the trade of the port, I would propose that the basin should be made considerably deeper than it was before,—say to about low-water spring tides; that the excavation of the basin should be extended upwards to nearly the line H I on the plan, the present extent being at the dotted line between the section lines E F and F G, this excavation, and consequently the quay-walls, getting more shallow toward the upper end; then continuing down on the south or west side between the harbour and the river, a pier for about 220 feet in length, and facing up the bank of the river toward the bridge, with a stone bulwark founded several feet deep into the bottom, to prevent the river from again breaking into the harbour. And, in order to give more room for the water of the river at the bend, I would propose to cut out a piece of rock which lies on the opposite side of the channel, which is shown in the plan, and sections E F, F G, G H, and H I.

The parts of the quay-walls which are extended, or which have to be rebuilt in consequence of being thrown down, are tinted a lighter colour on the plans than the others. I am uncertain whether the present wharf-wall, from Q to the line E F, would stand to be underfounded; and this I believe could not be known without making an experiment upon it. There is a rubble wall which extends westward from the line E F to F G; but as it is so frail and so high-founded it would have to be taken down. From the lower end of the proposed pier a dike should be carried similar to what there is at present, but a little higher, for keeping the run of the river, and the sand and gravel carried down by it, out of the harbour.

The only objection I perceive to building the south or west pier is, that, of necessity, from the contracted space between the houses and the opposite bank of the river, the width of the harbour at that place would be but small; but as it would vary from 50 to 80 feet, it would give accommodation to a number of herring-boats during the fishing season; and, if still additional accommodation were required, the bulwark which extends from the pier toward the bridge could be so built as to allow boats to lie at it to discharge.

I have in the annexed estimate stated the expense both ways: were this wall to be made suitable for boats, there are a few small houses near the side of the bridge which might be purchased, to give additional room on the quay.

That portion of the pier-walls which was thrown down would have to be rebuilt, and also, for the sake of quieting the water in the basin, a portion of the jetty which was there before; and as the foundation of it, and of several parts of the pier, have been washed away, it will be necessary to be very careful in preparing the foundations: for the purpose of securing them I would propose that the bottom, which consists of sand and loose gravel, should be dredged out 4 or 5 feet below water-mark, extending for 8 or 10 feet outside of the line of wall, that an artificial foundation, consisting of rubble-stones, should be laid under the water, filled with concrete made of Scotch lime, broken stones, and small gravel, and extending outside of the wall 6 or 8 feet, sloping outwards and downwards, and rising under the wall to within 1 foot or thereby of low-water mark; this would soon consolidate into one mass, and form an artificial stratum on which the pier would stand. This would only be necessary, I apprehend, at the jetty and part of the pier adjoining it, which will have to be rebuilt; the foundation of the bulwark, from the lower end of the south or west pier to the bridge, can be secured by digging to low-water spring tides, or 2 or 3 feet into the bottom, founding it with large rubble-stones, fortified by a quantity of rubble outside toward the river.

There is another mode of securing the foundation, which, if it could be carried into effect, would be equally secure, which is to drive piles, say 10 or 12 feet deep, after the ground had been dredged 4 or 5 feet below low-water, then filling up round about these piles to within a little of low water with broken stones, which would defend the piles from the river, and, were there any cutting outside, would prevent the river from acting on the piles; for if a river get acted upon piles it has a great tendency to cut down beside them; the difficulty of driving piles in such a bottom as Helmsdale is the greatest obstacle to this mode; the difference of expense betwen the two ways would be trifling.

The next subject to advert to is the entrance to the harbour, and extension of the harbour outwards; and here it appears to me much good cannot be effected but at a very great expense. Were piers to be built they would have to be carried out to about the present beacons, so as to form the entrance outside the bar, and nearly in the course of the present channel of the river, as marked on the plan, which is nearly in the position pointed out by Mr. Rennie many years ago, the only difference being in the situation of the entrance, the river having now shifted its course more westerly, and thrown up a high bank of sand and gravel where his entrance was shown.

Were piers carried out according to this plan, the harbour would be enlarged to three or four times its present extent; but, rapidly as the trade has increased, I fear the expense would be more than such an increase would call for. I did not carefully survey the course of the piers, only took a few measures and soundings (the position of the beacons is accurately laid down), but it appears to me that they could not be executed under 10,000*l.* or 11,000*l.*, and then there would be, from the nature of the foundations, being gravel, considerable danger of the piers being injured by the sea after being built. It would be advisable to carry out a short bulwark from the south point behind Methuen's property, to shelter the pier from the winds blowing from Tarbetness and outwards, as I was informed that such winds were most injurious to shipping while lying at the pier.

APPENDIX C.

HELMSDALE.

No 277.
Leslie, on improving the Harbour.

Were the alterations I have proposed carried into effect, the quay-room would be more than double what is in the basin presently, and nearly double the whole, including the outer pier, where frequently vessels cannot lie in safety; and more could still be obtained on the opposite bank of the river.

I am of opinion that, even although the outer and extended plan should be carried into effect, a considerable part of what I have proposed would have to be executed; and although in the course of a few years the harbour should have to be extended outward, the saving of interest of money, betwixt this and that time, would pay all I presently propose to be done.

I shall now proceed to lay before you estimates of the different works, founded on calculations made from actual measurements, only remarking that several parts of the plau could be omitted without deranging it.

	£.	s.	d.
Excavating and deepening the harbour to the state shown by the sections, containing 8861 cubic yards, at 9*d*.	332	5	9
Excavating rock on the western bank of the river, 1250 cubic yards, at 2*s*. 6*d*.	156	5	0
Rebuilding 360 feet lineal of quay-wall, from the lower jetty up as far as the quay presently extends, taking into account the value of materials presently in the walls	371	0	0
N. B. If the walls will bear underfounding, this sum, including new coping, will be 210*l*. (see end).			
Extending the quay-walls 235 feet farther up to X	365	0	0
Building new south or west pier-wharf, 220 feet long	329	0	0
Facing bulwark to river, from end of proposed new pier to the bridge, 460 feet long or thereby	323	0	0
Rebuilding jetty and part of pier adjoining, and preparing foundations for the sama	188	0	0
Taking down and rebuilding 60 feet or thereby of the lower pier at K, including preparing the foundations	87	0	0
Total for work on east side of river, including excavating rock	2151	10	9
Erecting south breakwater at the south end of Methuen's Point, 160 feet long	475	0	0
	£2626	10	9

If the present quay-wall will bear underfounding, the first sum would be reduced to 1990*l*. 10*s*. 9*d*.

Were the bulwark on the east side of the river extended from the point of the proposed new pier up to tha bridge, made fit for boats lying afloat, an additional expense would be incurred of about 280*l*.

I am, &c.,
WILLIAM LESLIE.

James Loch, Esq. M.P.,
&c. &c. &c.

No. 278.

No. 278.
Income and Expenditure.

Return of Income and Expenditure for the Years 1841–2–3.

INCOME.

Heads of Income.	1841 £.	s.	d.	1842 £.	s.	d.	1843 £.	s.	d.
Tonnage dues and warpage	99	4	6	120	17	7¾	114	17	1½
Export and import dues	110	18	3	112	5	3¼	111	4	4½
Total . £	210	2	9	233	2	11	226	1	6

EXPENDITURE.

Heads of Expenditure.	1841 £.	s.	d.	1842 £.	s.	d.	1843 £.	s.	d.
Salaries	50	0	0	50	0	0	50	0	0
Repairs to and clearing out harbour, with materials	49	6	3	35	15	4	92	1	6
Erecting additional wharf wall	783	15	0	..			..		
Total . . £	883	1	3	85	15	4	142	1	6

Dues levied under Act passed 1838.

GEO. GUNN.

LYBSTER.

LYBSTER.

No. 279.

No. 279.
Return to the Order of the House of Commons of 9th Aug. 1844.

Return to Order of the House of Commons of August 9, 1844.

Thurso, April 7, 1845.

SIR,

IN reply to your circular of 1st February, 1845, with reference to the port or harbour of Lybster, I beg leave most respectfully to state, 1st, That there are no Commissioners (or other persons) appointed under any Act of Parliament relative to said port or harbour; 2nd, That I have no map of said port or harbour; 3rd, That I have no report made by engineers or other officers respecting the said port or harbour; and 4th, That I have no copy of any complaint made to the proprietor of said port or harbour regarding the same.

I have, &c.,
MOR. SNODY.

The Hon. H. Manners Sutton,
&c. &c.

APPENDIX C.

LYBSTER.

No 280.
Additional notes by the Proprietor.

No. 280.

Additional Notes by T. F. SINCLAIR, Esq.

November 12, 1846.

LYBSTER is situated exactly in the centre of the line of fishing stations between Wick and Helmsdale, a distance of about 30 miles.

Six hundred boats, having generally crews of five men, besides boys, belong to this part of the coast.

There is no chance or hope of safety for one of these lives if the boats should be overtaken, at low-water, by an easterly storm; and these storms occur very suddenly, and with such violence, even during the herring season, that it would be impossible either to get off the coast or to reach Cromarty or the Long Hope, where alone they could obtain shelter. The only means of averting a calamity so imminent is, by providing a low-water harbour, accessible to these boats at all times, and with any wind.

The harbour of Lybster is at present dry at low-water; but the obstacles in the way of its being deepened to any required extent may be removed at an incredibly small expense. The fairway is blocked up by a succession of loose but very long and weighty stones, which are partly visible at low-water, though immediately outside of them there is a depth of several fathoms. In the bottom of the present basin there is an ascertained depth of more than 16 feet of shingle, earth, and clay.

The action of the sea in ascending and retiring along the sloping rock and deep fissures on one side of the fairway renders any accumulation of lighter materials than those which are now found there impossible, that is, after these shall have been removed.

T. F. SINCLAIR.

No. 281.
Return to the Address of House of Commons of 29th July, 1844.

No. 281.

Return to Address of the House of Commons of July 29, 1844.

December 31, 1844.

THIS harbour is situated on the east coast of the county of Caithness, and forms part of the estate of Lybster, the property of Temple Frederick Sinclair. It was projected many years ago by Mr. Sinclair's father, the late General Sinclair, of Lybster, for the benefit of the fisheries, and as a sort of Harbour of Refuge so much wanted on that part of the coast. In its construction and erection the proprietor has expended several thousand pounds.

Previous to the construction of the harbour, there were a few fishing-boats belonging to the village; but from the exposed situation of the shore and the almost unnavigable state of the rivulet at which they had to land, the fishing was precarious, and even dangerous. The pier which has been erected is 280 feet in length, 30 feet in breadth, and from 16 to 27 feet in height; and, by excavations made to a considerable extent, decked vessels can now lie alongside the pier in safety. So important is the accommodation afforded, that there are now upwards of 100 large boats annually engaged in the herring fishery; and from 20 to 30 vessels annually discharge cargoes of salt, &c., and load cargoes of herrings, by means of the pier.

The pier or harbour is not yet completed to the full extent contemplated; but the proprietor, having expended a very large sum of money on what has been already done, is unable at present to carry forward the projected extension. There is an annual outlay of 150*l.* and upwards in deepening the basin, repairing the pier, and making necessary excavations.

There are certain rates paid by vessels and boats entering the harbour, as a small return for the safety and protection afforded to them, and for the use of land-fasts.

Such rates do not properly fall under the denomination of harbour-dues, but may rather be termed shore-dues, for the safety and security thus afforded to life and property.

Income and Expenditure.

Return of Income and Expenditure for the Years 1881–2–3.

INCOME.										EXPENDITURE.									
Heads of Income.	1841			1842			1843			Heads of Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Dues on vessels in the herring fishery	65	10	0	67	5	0	64	2	6	Cleaning, repairing, and improving the harbour	249	15	8	184	14	5	41	17	6
Dues on herrings shipped . . .	33	6	8	39	0	0	41	0	0										
Total . £	98	10	8	106	5	0	105	2	6										

Private property, belonging to T. F. Sinclair, Esq.

MORRISON SNODY.

WICK.

No. 282.

Appendix C.

Wick.

No. 282.
Evidence taken on the 21st September, 1846.

Examining Commissioner—Captain Washington, R.N., F.R.S.

Present:—Mr. J. Henderson, of Rosebank, Bailie Campbell, Messrs. J. Cleghorn, — Crawford, Hugh. Davidson, Collector of Customs, D. Bremner, W. Macpherson, Jos. Bremner, J. Loutlit, Lieut. Medley, R.N., Inspecting Commander of the Coast Guard, A. Auld, C. Cook, and many pilots and fishermen.

The Commissioner opened the proceedings by reading the Royal Commission authorizing the present investigation. He then stated that this was an inquiry into the past and present state of the Harbour of Wick, and its capabilities for improvement; that the meeting was public; and that, after examining the authorities, he would be glad to hear the remarks or suggestions of any shipowner, pilot, fisherman, or sailor, or, in fact, of any one interested in the welfare of the port.

He regretted extremely that there was no one present to represent the British Fisheries Society, to whose public spirit he believed they were indebted for all the improvements that had taken place in the harbour; but as he understood Mr. Rhind was absent on account of pressing domestic affairs, he would request him afterwards to send in his written statement; and in the meantime he would be glad to receive all the information that could be obtained from the gentlemen on the spot.

Mr. James Bremner, *Civil Engineer*, examined.

Had been resident 40 years in Wick. The present works of the harbour of Wick, or Pulteney-town, were commenced in 1807, at the expense of the British Fisheries Society, from a design by Telford, and the old harbour was completed in 1811 at a cost of 16,000*l*. This harbour being found too small and much sanded up, an outer or south harbour was begun in 1824, from a design by Telford, Mr. John Mitchell being resident engineer. Witness was principal contractor for the works, which were completed in 1829 at a cost of 21,000*l*, paid by the British Fisheries Society. The object of the erection of the south piers was to obtain a depth of three feet at the entrance of the harbour at low-water springs. The quays and piers are constructed of undressed whinstone and slate blocks from the neighbouring quarries, laid dry; they vary in size from one to eight tons, some reaching to 30 tons weight. The eastern wall, with its parapet, is 30 feet high, and rises 20 feet above high water. During the construction of the works, in consequence of a severe storm, part of the north quay gave way, which caused him much additional expense. The south pier-head was obliged to be taken down for 120 feet. Since its completion the harbour had much sanded up. The width of entrance of the outer harbour is 80 feet; and it has 10 feet depth at high-water springs, and 7 feet on neaps. The extent of quayage is 2500 feet, but far more accommodation is wanted during the fishing season; and especially a low-water pier or harbour is needed. There are no cranes, but two are in progress of erection. The whole area of the two harbours is about 12 acres; the area of the quays 2 acres.

Owing to the want of accommodation, he had given a plan for a new outer harbour, to the eastward of the present. He would propose, first, to run out a pier from the Salmon rock, in a N.N.E. direction, to a distance of 330 feet into the bay, having 13 feet at the pier end at low-water springs; this would cost 16,000*l*. At some future period he proposed to convert the space between, into a harbour, by continuing the present north wall in an E.S.E. direction, towards the outer end of the south pier, leaving an entrance of 100 feet in width, thereby gaining a third harbour of about 8 acres area, if the rocks were excavated, having an average depth of 7 feet at low water, and 16 feet at high-water springs. A part of the plan was to close up the entrance into the present outer harbour, and make an opening through the present south pier; the estimate for the whole of these works was 30,000*l*., to be advanced by the British Fisheries Society. Witness proposed building the walls on a plan of his own, for which he had taken out a patent, and had perfect confidence in its success. He considered that the works would be begun soon, and that the harbour, when finished, would not sand up. The piers and walls would be built on the upright principle, which he much preferred to the long sea-slope, which, in his opinion, invited the seas to break with greater force. His plan had been submitted to Mr. James Walker, the well-known eminent civil engineer, and had been approved of by him.

Bailie Campbell.—Seeing the want of a deep-water harbour on this coast, would it be practicable to erect a detached breakwater on the north side of the bay of Wick to which vessels might run in case of danger and have access at all times of the tide?

Mr. Bremner stated that it was perfectly practicable to erect such a breakwater; that there was no harbour of refuge between Orkney and Cromarty; that in 1812 he had given an estimate of the cost of such a building, which amounted to 130,000*l*.; that were it erected, many shipwrecks would be prevented and many lives preserved. Numerous wrecks take place along this part of the coast. On the 20th August, 1845, a north-west gale and heavy swell came on suddenly, when 20 fishing-boats and 4 lives were lost. In a distance of 21 miles, 110 boats were wrecked. Three-quarters of a mile of a breakwater, in a depth of 11 feet at low-water springs, or 20 feet at high water, would be requisite in order to get any useful shelter in the bay. The great evil to fear would be the sand, which comes both down the river and from the sea.

Mr. A. Auld corroborated the remarks of Mr. Bremner relative to the necessity of a breakwater: on one occasion 27 vessels were lost on the coast, and many boats perished.

Lieut. Medley, R.N., *Inspecting Officer of the Coast Guard.*

Had been seven years on this part of the coast, either at Thurso or Freswick. He could not concur in the benefit to shipping likely to arise from a breakwater in Wick bay; not only from his own experience and observation, for he felt certain the space inside would sand up, but also from the statement uniformly made by shipmasters, who had told him that they would not run the risk of making the coast of Caithness even were there a breakwater erected as proposed. He considered that all the money was laid out at Pulteney Town, whereas, if the benefit of sailors and fishermen were the real

Appendix C.

Wick.

No. 282.
Evidence taken on the 21st September, 1846.

object of the outlay, a part might be expended at Broadhaven with great advantage; a small sum, well laid out there would be of essential service to fishermen. Boats could always be afloat there, and berthage for 200 boats might be found, even vessels of 100 tons have rode a gale out there.

Mr. Stephens, pilot for 30 years, and belonging to Broadhaven, fully confirms all that Lieutenant Medley has stated. There would be ample room for 200 boats at Broadhaven; the harbour is quite safe. On the 20th August, 1845, when so many boats were injured at other stations, they rode in safety at Broadhaven; and boats had frequently run there when they could not approach any other harbour along the coast.

Mr. C. Cook was of opinion that a sailor's advice was not much followed in the harbour affairs at Wick. The harbour had sanded up materially within his recollection. If a breakwater was wanted, a few of the old three-deckers and seventy-fours that lie at Portsmouth might be sent down, filled with stones and sunk. They would soon get plenty of sand to fill them up.

The Commissioner inquired for the harbour books in order to examine them, when it was stated that they had been left with Mr. D. Davidson, who had gone to Orkney.

Mr. Hugh Davidson, *Collector of Customs*, examined.

The arrivals and sailings of the port, including the creeks between Freswick and Dunbeath, about 40 miles, are, annually, 122 foreign of 33,000 tons, 664 coasting of 35,000 tons. The revenue of the harbour was 1200*l* in 1845. Two thousand fishing-boats come here during the season, employing 10,000 men as fishers in the herring fishery for about seven weeks. The value of the fisheries may be 100,000*l*. There are 1818 tons of sailing vessels belonging to the port; no steamers, but one calls off the harbour weekly to and from Orkney. Coals for steamers can be procured at from 14*s*. to 16*s*. per ton. Fresh water is led in pipes down to the quays for the supply of shipping. About 50 men are employed in building and repairing ships.

He considered that the present harbour should be deepened and stones placed under the foundations along the north quay; a deep water harbour is much wanted for vessels of large tonnage. Vessels were frequently prevented getting into or out of the harbour from want of water. This day, on the height of spring-tides, a vessel called the *Enterprize*, drawing 12 feet loaded, is lying near the mouth of the harbour, but cannot get out from want of water. Large boulder-stones lie at the entrance. Should a gale of wind come on, that vessel must receive damage. The sand in the harbour instead of being cleared out with a steam-dredge. is only taken out by lighters and in carts. There is no steam-dredge, and possibly a steam dredge could not work while boulder-stones are lying all over the bottom of the harbour.

The Commissioner expressed his surprise at such a state of affairs; and added, that it appeared to him extraordinary that the British Fisheries Society could propose to lay out 30,000*l*., or, more probably, 50,000*l*., in carrying out new works, and yet could hesitate to spend a few hundred pounds in dredging the present harbour, in removing the large stones, and in clearing the channel of the river up towards the bridge, which, in his opinion, would be the least expensive mode of providing further accommodation for the fishing-boats. There was only one mode in which he could reconcile such an expenditure, namely, by the consideration that there was no low-water harbour along the whole coast for which fishing-boats could run if caught in a sudden gale; and if it were with the object of supplying such a want, and that no more appropriate spot could be found along the coast, the construction of such a harbour would be highly creditable to the Society. Still, as such a harbour could hardly be constructed under three years, he was of opinion that in the mean time they would best consult their own interests by expending a few hundred pounds in clearing out the old harbour.

Mr. Crawford stated that a merchant, who had made large purchases of herrings, had told him lately, that unless the harbour were deepened so that vessels might get out at high water, both at neaps as well as springs, which they had a right to expect, he would be compelled to go elsewhere. Witness complained that no exertion was made to remove the stones from the harbour; that sand, taken by lighters out of the harbour, is thrown into the river at the back of the north pier; several vessels have suffered damage in the harbour, and some have been bilged.

Messrs. Henderson, Joseph Bremner, Macpherson, James Louflit, and others, concurred in what had been mentioned by the preceeding witness as to the state of the harbour, and in the absolute necessity for its being cleared of sand and boulder-stones, if there were any desire to retain the trade of the port.

Mr. P. Taylor.—Has been harbour-master for 11 years, and received his appointment from the Society's agent. He thought that the bay generally had become much shallower since he had known it, in parts as much as five feet; and the harbour had sanded up, but it had been constantly cleaned by means of carts and lighters. No steam dredging-machine had ever been used. The chief damage is caused by stones at the entrance. Vessels have grounded on the rocks; and one, loaded with lime, took the harbour when the tide was out and was burnt. Two smacks were wrecked last year, and one, the *Janus*, this spring. A wall is wanted to be carried round the road at the back of the north pier; it would probably cost 5000*l*. Considered that the present harbour should be deepened. Vessels were frequently prevented from getting into or out of the harbour from want of water. Spring tides rise nine feet, neap tides rise to seven feet, above datum or low-water springs; they range about five feet. South-easterly winds cause the greatest deposit of sand.

The trade of the port was rapidly increasing. Did not know what sums were annually expended in harbour improvements—perhaps 100*l*. a-year, on an average, for removig sand; but nearly 500*l*. a-year had been expended on paving the quays and roadways, if these might be termed harbour improvements; the income he believes to be about 1200*l*. a-year. There were no cranes on the quays, except an old one, which did not belong to the Society; but there were two new ones about to be erected. The affairs of the harbour were managed by the Society's agent; there were no trustees.

Messrs. Crawford, H. Davison, and others, remarked, that sometimes, out of courtesy, the Pulteney Town Improvement Commissioners were asked their opinion; but, strictly speaking, they had no voice in the management of the harbour affairs.

Mr. Taylor, continued.—There are 16 pilots belonging to the harbour, that is, two boats' crews; their charge is 3*d*. per ton. The pilots pass no examination, but obtain their licences on producing certificates of character from two shipowners and two shipmasters. Neither masters nor mates of ships pass any examination. About 200 seamen belong to the port, 600 fishermen, 100 coasters, and 50 boatmen; the whole population is 5000 persons. The dues levied are 2*d*. a-ton on all vessels from 15 to 45 tons, and 4*d*. per ton on all above; fishing-boats pay 8*s*. each the season; goods pay 4*d*. per ton generally. Export dues on barrels of herrings 1*d*. each; last season they amounted to 110,000

Appendix C.

Wick.

No. 282.
Evidence taken on the 21st September, 1846.

barrels. The bye-laws and tolls are painted on a board and exhibited on the quays, according to Act of Parliament. There is a life-boat with paddles, to be moved by a crew of 16 men, instead of oars, constructed by Mr. Bremner; and there is a supply of Dennett's rockets kept ready for use.

Lieutenant Medley, R.N.—In reference to Ackergill, he considered that a landing place, or low-water pier, is much wanted there; he had frequently seen the steamers obliged to go round there to land their passengers. Mr. Bremner had made an estimate of such a pier at 7000*l.*; but he hoped and believed that one sufficient for the purpose, and for the comfort and safety of passengers, might be erected for much less. He was of opinion also that there should be a pilot-cutter for vessels going through the Pentland Firth; the present row-boats were quite insufficient for the purpose. A lighthouse is to be erected at Noss Head, that is, the engineer for the Northern Lights has visited the spot; but he thinks that Elzie Point, at the extreme east point, should have been lighted in preference. The reason, he believes, for selecting Noss Head was, that the light would be visible throughout Sinclair Bay, which, in strong N.W. winds, affords good anchorage for ships bound through the Firth. From Tarhet Ness to the Skerries there is no light along a range of coast of 60 miles; and it is not surprising that we hear of wrecks in Sinclair Bay, caused by vessels mistaking Noss Head for Duncansby Head when steering for the Pentland Firth. The lights to be placed at Noss Head will, it may be hoped, remedy this evil. *See* Appendix No. 284.

The Commissioner stated that he was well aware of Lieutenant Medley's exertions with respect to the placing of this light, as well as for the benefit of shipwrecked seamen along this part of the coast, and such conduct was highly creditable to him.

Mr. David Bremner fully agreed with Lieutenant Medley as to the necessity of a decked pilot-vessel to cruize off the harbour, ready to put pilots on board ships bound through the Pentland Firth. Nothing would tend to raise the character of the port of Wick among sailors and shipmasters more than an active and efficient set of pilots. Lieutenant Medley had suggested to the Committee of the House of Commons in 1843 the examination of pilots.

Donald Gunn, pilot, confirms all said above with respect to the wants of the harbour; but was not so clear as to the necessity of more lights along the coast; nor as to the want of a decked pilot-vessel to cruize outside the harbour. Suppose they had her, where was the low-water harbour in which she could seek shelter in time of need; all are tide harbours along the coast; and such a state of things, he thought, would prevent her use; in calm weather, too, a row-boat would be far more convenient.

The Commissioner said, in conclusion, that while the affairs of the harbour of Wick, or Pulteney Town, were administered by so benevolent and wealthy a body as that of the British Fisheries Society, he trusted that it would not be left behind hand in the rapid march of improvement which was going on in all our harbours. Here, too, there was additional cause for exertion, as a large body of fishermen, on the faith of finding a good harbour under their lee, had been induced to resort to this part of the coast; and the value of the boats, and still more the security of their lives, entitled them to demand that the utmost should be done to afford them shelter and accommodation that the harbour was capable of.

After the inquiry, the Commissioner, accompanied by Mr. Bremner, engineer, Mr. Henderson, and some other gentlemen, made a personal inspection of the quays and harbour, and caused to be pointed out to him the site of the proposed pier from Salmon Rock.

[Mr. Raind, *having been absent from Wick during the inquiry there, submits the following statement*]

Rhind's statement on the Harbour.

The inner harbour of Pulteney-town, at the time of its erection, was considered a very extensive undertaking, and sufficient for the accommodation and protection of the boats and shipping resorting to it. Trade progressed, and consequently it was found necessary to build the outer harbour, at a cost exceeding 20,000*l.*; of late years, however, both became insufficient, because they are not suited for vessels of a large draft of water, and cannot contain the number of boats annually resorting to them for the fishery. It is in contemplation to erect a low-water harbour where vessels can enter or depart at every state of the tide. The bay of Wick is sandy; and from the position of the entrance, during winter storms, sand accumulates in the harbour to a very great extent, which is both annoying to the trade and expensive in its removal. From the situation of the proposed harbour, persons of long residence and experience in the place, affirm that very little, if any, sand will be driven into it by the violence of the sea. The directors of the British Society for extending the fisheries, &c., are ready to enter into contract for the southern portion of the new harbour, at which steam-boats and large vessels might load and discharge their cargoes. By such an addition, trade would increase, commerce receive a new impulse, and the value of every description of property in the county would be enhanced.

Every possible exertion is made for the removal of the sand by means of carts, lighters, &c. The part of the harbour most frequented by the shipping, namely, the North Quay, is as deep as at the time when the harbour was being built: the foundation stones are level with the surface of the sand or bottom of the harbour; thus obviously showing that the depth of water has not diminished but increased, and such is the case in other parts of the harbour. That Thomas Stevenson, Esq., C.E., recommends, as well as James Bremner, Esq., C.E., that the quay wall, previous to the excavation of the low-water tract or channel should be underfooted with stones of a large size; and they are both of opinion as to the impossibility by artificial means to obtain permanently any very appreciable increase of its depth, and strongly recommended that the most effectual and judicious method of improving the port is by the erection of the new harbour, which will give greater accommodation and depth of water.

The harbour-master draws out an abstract of the rates and duties levied in the harbour annually, and makes oath that he collects them agreeably to Act of Parliament, and allows no evasion of them directly or indirectly. The superintendent of the harbour works keeps an account of the labour performed, pays the men, in presence of the deputy harbour-master and clerk. These accounts are attested by them as to their accuracy. The tariff of dues is considerably under those of any other port; the articles required for our staple trade, the fisheries, such as empty barrels, hoops, staves, headings billet wood, and burn wood, are exempted from the payment of any dues, and 3*s.* only charged from feuars for boats, and 1*d.* per barrel on herrings shipped, and 4*d.* per ton on coal, lime, salt, &c. The harbour accounts, showing the receipts and expenditure, have to be examined annually by an auditor, appointed by the Lord Advocate, and lodged with the sheriff clerk of the county, for the use of the public.

APPENDIX C.

WICK.

No. 282.
Rhind's statement on the Harbour.

		£.	s.	d.
The revenue in 1844 was	. . .	1,251	16	9
1845 ,,	. . .	1,207	3	4
1846 ,,	. . .	1,334	0	9

The expenses for repairing the quays, roads, communicating with the harbour, and for the removal of sand, would average 300*l.* per annum.

An iron crane of great power is erected, and another one is on the spot to be placed on the quays; a life-boat is in readiness when required, and promises to be very useful in cases of necessity. Rockets are on the spot.

It is to be regretted that there is no low-water harbour, or harbour of refuge on this coast, where vessels and boats can shelter on all occasions of distress and at every stage of the tide. In the Wick district there are about 1000 boats engaged in the herring fishery, with five men in each boat; 451 boats land their herrings in the harbour.

I send you, in a separate paper, an account of the calamitous disaster of the boats on the Caithness in August, 1845.

How the men and boats would be preserved in case of a storm is a matter worthy of great consideration. In my opinion, the most efficacious method for preventing such another catastrophe would be by forming Wick, or some such other bay, into a harbour of refuge. Sinclair's Bay is certainly the best on this coast, if done on an extensive scale.

Wrecks frequently took place in Sinclair's Bay; but as a light is now being erected on Noss Head by the Northern Commissioners, it is hoped it will be a preventive in future to vessels taking one headland for another in sailing for the Pentland Frith.

There have not been 40 tons of sand thrown over the harbour wall for many years, and any person stating otherwise does not state the fact. The sand is all carried, making up ground on the river side, within an enclosure.

JOSIAH RHIND.

No. 283.

Return relative to Acts of Parliament, Reports, &c.

No. 283.
Return relative to Acts of Parliament, &c.

SIR,

Whitehall, April 7, 1845.

IN obedience to the instructions issued from the Home Office, in conformity with the resolution of the House of Commons, dated August 9th, 1844, I have now the honour to state, that the harbour of Pulteney Town, Caithness, is under the control of the Directors of the British Fisheries Society, acting under the authority of an Act passed in the year 1814, intituled, "An Act to enable the Governor, Deputy Governor, and Directors of the Society called the 'British Society for extending the Fisheries and improving the Sea-coasts of this Kingdom,' to levy certain rates and duties on Vessels frequenting their Harbours;" and also under the authority of the Act 7 and 8 Vict. cap. 52, intituled "An Act to explain and amend the Acts incorporating the 'British Society for extending the Fisheries and improving the Sea-coasts of the Kingdom;' for enlarging and improving the harbour of Pulteney Town, in the county of Caithness; and for lighting, cleansing, and improving the said town, and better supplying the same with Water." I have the honour also to forward herewith copies of plans of the harbour and port, prepared by Mr. John Gibb of Aberdeen, civil engineer, and by Mr. James Bremner of Wick, Civil engineer, each of which also embraces certain proposed extensions of the works, these being the only plans in the possession of the directors which exhibit accurately the present depth of water in and near the harbour.

Complaints have been long and justly made of the harbour of Pulteney Town, in respect of the inconvenience arising from the accumulation of sand, by which the access to the harbour, and even its outer basin, are always more or less impeded, and the traffic is greatly interfered with, steam-boats being unable to approach, to land their passengers or cargoes; and next, in respect of the insecurity of vessels even in the outer basin, at times when a heavy swell comes in from the north-east.

Similar inconveniences had been experienced from the time of the original construction of the harbour, then consisting of one basin only. These the directors hoped to obviate by the construction of the second or outer basin. They have been disappointed; and they now have before them for consideration the designs exhibited in the accompanying plans for remedying these evils, by the construction of a third basin in deeper water. The cost of making and maintaining the existing works and establishment for about 30 years has been 48,000*l.*; the dues received about 27,000*l.* The estimate for the whole of the proposed extension is 26,900*l.*

The directors are in possession of a Report by Mr. Gibb, recommending the use of lighters and a dredging apparatus for the removal of the sand instead of carts, to which this operation had till lately been confined. He calculates the cost of removal at 1694*l.* and of subsequently keeping it clear at 80*l.* per annum: the sand to be applied in embankments for building ground. He further recommends the construction of a steamboat pier at the point shown in his plan; as, in his opinion, the present harbour cannot, with safety to the foundations, be dredged deep enough to admit steamboats of the size which he anticipates will be generally adopted for the coast trade.

From Mr. Bremner the directors expect shortly to receive a Report, explanatory of the reasons for expecting that the proposed extensions of the harbour will be exempt from the mischiefs which have crippled the utility of the existing harbour.

The Hon. H. Manners Sutton.

I have, &c.,
SAMUEL SMITH,
Secretary of British Fisheries Society.

No. 284.

Extracts from Lieut. MEDLEY'S *Official Correspondence with the Comptroller-General of the Coast Guard and the Admiralty, respecting Harbours, Lights, Pilots, &c.*

No. 284.
Medley, on Harbours, Lights, Pilots, &c.

Freswick, Caithness, April 10, 1840.

VESSELS from the southward are either of the outward or east-country foreign trade; these, with even a leading wind, unless very strong, rarely attempt Pentland Firth until the turn of tide, consequently, in light or contrary winds, they generally anchor in Sinclair's Bay. In this Bay the facilities for smuggling, in the character I have before mentioned, are great, from its proximity to Wick, where purchasers may at at all times be found, both for spirits and Baltic produce.

Ackergill, I am informed, is selected as a harbour of refuge, possessing more advantages than Wick, both as to outward and inward shelter; this, in my opinion, should be the head station, as commanding Sinclair's Bay, and as being within easy distance of the custom-house.

Within the half-year there has been no less than 100 sail of vessels, wind bound, at anchor in Sinclair's Bay; at one time no less than 40, often 10, mostly from the Baltic; these vessels, I have found, frequently pay their pilots with perhaps deck cargo in lieu of pilotage. Vessels from America, timber laden, get rid of their deck lumber in either this way, or by previous agreement their spars and timber-ends are disposed of, and thus evade the duties beyond our power of prevention. Coal, another article, although of the least importance, has been brought on shore to this place for sale, and has been taken by the pilots in lieu of money, which was not obtainable from the vessels which they had taken through the Firth.

To the Right Honourable the Earl of Haddington.

MY LORD, *Freswick, by Wick, November* 26, 1844.

ADVERTING to the subject of a former letter I had the honour to address to your Lordship, of the necessity for a light on Noss Head, and seeing no steps taken towards so desirable an object, and it being reported, but with what truth I will not hazard an opinion, that if a lighthouse could not be had on Sarclet, there would be none at all, I take the liberty of enclosing, for your Lordship's information, a statement of six casualties and wrecks since the 3rd of September last—two of which were total wrecks; one with the loss of all her crew except one man; two were lost close to the south side of the Head; the remainder to the northward. The vessel noted on the 11th instant was a foreigner; and had she gone on shore, from which she had a very narrow escape, none could have lived to have told the tale, although it was daylight.

My Lord, I have sought no commendation—have been ambitious of no praise or reward; but, observing in the papers that, on Her Majesty's visit to Dundee, approbation was expressed of the manner in which the Tay was buoyed, in common justice to myself I am bound to lay before your Lordship the following statement:—

In October, 1835, I joined the Westhaven station on the right bank of the river Tay; in the period of the three following years, no less than 23 sail were wrecked, and the greater part of the crews perished. I wrote to the Trinity Board; my letter was referred to the Northern Lights Commissioners, who directed their engineer to examine; he reported the Tay to be "well buoyed and lighted," although at that time there were only two or three buoys (I believe, two). Still wrecks went on. I then interested the member for Perth, Mr. Kinnaird, on the subject, who wrote to Lord John Russell, then Secretary of State. I will not trouble your Lordship with every detail, but in the end I was asked my views; I simply recommended a sufficiency of buoys, of black or red on one side, and chequered on the other, and periodical surveys. It was adopted; since which, I am informed, no wreck of any importance has taken place, and certainly no lives lost. I have not the account of the wrecks to forward to your Lordship, having left it with the Committee of Shipwrecks of the House of Commons in 1843, but Lord Kinnaird gave me his kind assistance, and can vouch for the truth of this statement.

To Rear-Admiral Bowles, C.B., M.P., Chairman of the Tidal Harbours Commission.

SIR, *August* 22, 1845.

THE recent awful calamity, attended with loss of life, boats, and nets, by bad weather, at Wick, last week, I hope will be received as my apology for troubling you as Chairman of the Tidal Harbours Commission.

I have, Sir, on more than one occasion, called the public attention to Sinclair's Bay, and have brought under Lord Haddington's notice the necessity of a lighthouse on Noss Head—the headland that forms it, also the Bay's eligibility for a harbour of refuge; I feel, Sir, more justified in calling your attention, as the survey of the Bay is now complete, and the officer who performed that duty coincides with my opinion as to the necessity, and points out a spot where a pier on an excellent foundation might be erected at little expense, and carried out from 2½ fathoms to 6 fathoms water.

When I joined this station, in 1840, I presume the number of herring-boats that rendezvoused at Wick might be about 800, now, I believe, they exceed 1200. The harbour of Wick is very small for so large a number in addition to its ordinary trade; besides, it is becoming each year more difficult of access from the deposit of sand from the river; and were this not the case, it never can be useful as a harbour of refuge, as its entrance is very narrow and shallow, such as no master would be justified in running for in a gale with any sea on. I am told, but with what truth I cannot pretend to say, that in answer to a petition to Parliament, a grant of money was made to improve the place; while I am also informed, that each improvement by pier building that has been made, has only tended to make it worse. I may be opposed in this opinion by the Fishery Board and the inhabitants—their motives may be understood; I speak as a naval officer, independent of motive, and from my situation in the Coast Guard; and as Agent of the Shipwreck Fishermen and Mariners' Benevolent Society, I am

Appendix C.

Wick.

No. 284.
Medley, on Harbours, Lights, Pilots, &c.

enabled to glean the unbiassed opinion of the fishermen themselves; and I presume to offer, as my opinion, that any outlay on Wick Harbour would be a waste of money, while, on the other hand, had half the money that has been already expended been laid out in a pier-harbour at Ackergill, in Sinclair's Bay, which is two miles by land from Wick, a harbour might have been formed without fear of filling up, capable of taking vessels of any draft of water at any time of the tide, and treble the number of boats that now resort to Wick. At this place the steamboat now delivers and receives her cargo when she cannot approach Wick. Again, Sir, opposite Ackergill, about four miles distant, is the pretty tidal harbour of Keiss, dry at low water; there are 17 large, and 6 small boats, out of that place. I am informed that the harbour works cost between 2000*l.* and 3000*l.*; about 2000*l.* more laid out in improving it would make Sinclair's Bay, as possessing these two places of refuge, a place of the utmost importance on this east coast and iron-bound shore, besides becoming places of retreat in the fishing season. Sinclair's Bay is about seven miles wide, with an out-set of tide on either tack, that any vessel may work out of it; it possesses good holding ground, is free from any hidden danger, and is only open to winds from E.N.E. to S.S.E.

I beg, Sir, you will receive my apology, as actuated by desire of good arising from the late losses. I see and know the conflicting private interests that militate against a public good; but I sincerely hope, Sir, through your instrumentality, some steps may be taken to prevent a recurrence of such damages that now happen to a most important staple of the kingdom, occasioning with it, also, although in humble life, much domestic affliction.

Letter of Thanks from the Shipowners and Masters of Banff.

Sir, *February* 17, 1845.

We had the pleasure of forwarding to the Commissioners of Northern Lights a Memorial, through you, pointing out the public advantage of having the site for a lighthouse on Noss Head in place of Sarclet Head; and your indefatigable exertions in support of the said Memorial, and to promote a public good, having now come to our knowledge, we think it our duty to return you our warmest thanks.

W. Scott, *Provost.*
James M'Donald, *Lloyd's Agent and Surveyor.*
W. Hossach, *Shipowner*, and
Thirty-six others.

To Lieut. Ed. Medley, R.N.

To the Right Honourable Earl of Ellenborough, First Lord of the Admiralty.

My Lord, *May* 8, 1846.

Upwards of two years ago I had the honour to bring under the notice of Lord Haddington the necessity of a lighthouse on Noss Head, having, during a period of four years' residence in the Coast Guard at Freswick, witnessed its necessity, from the number of wrecks during that period; and in this opinion I was supported by a Memorial sent to me to forward to the Northern Lights Commissioners, by 50 owners and shipmasters of the port of Banff, besides letters on the subject from Sunderland and Liverpool.

At the period I allude to, a light was contemplated to be erected at a place called Sarclet Head; private interest, not public good, was here studied. I opposed it; hence arose the support I received from the ports before named. The subject was referred to the Trinity House and to the Hydrographer, who decided on Noss Head as the place for a lighthouse.

Since the commencement of the present year I have been removed to this place, close to the vicinity of Noss Head. In the short period of my residence here, I have been more and more confirmed in the opinion I before entertained. The season of the Baltic trade is now commencing, to which Noss Head is the great land-fall to the homeward-bound trade; each year brings with it its disasters, which would be obviated by the light, and which would have been erected long ere this, I feel assured, had the same influence been exerted for Noss Head as was used for Sarclet.

I must entreat your Lordship's pardon for the liberty I have taken in bringing the subject under your Lordship's notice; but I feel it is my bounden duty as a naval officer in charge of the coast, and having for six years and upwards witnessed wrecks and casualties arising from the want of the light, to entreat your Lordship, as conservator of the coast of the kingdom, to be pleased, now the site is determined upon, to cause such acceleration of the progress of the work as may seem to your Lordship most expedient for so desirable an object.

Extracts from Letters respecting Pilots.

Sir, *December* 17, 1842.

When I joined this station, of course my first inquiry was as to the nature of smuggling. The extra-men of this station having been pilots, afforded me much useful information. By them I learned that the pilots are frequently paid for their pilotage, in part money, in part stock or cargo; this fact has come within my personal knowledge and was last year reported in my official Reports on Smuggling, dated the 10th of October. I also found that the description of boat generally used by the pilots was, from their poverty, so very fragile as to occasion much loss of life annually; last year two boats were lost off this station—one with the whole crew, this being their second boat; the crew of the other boat were saved by a merchant vessel; for these people I obtained 10*l.* from the Shipwreck Fisherman's Society, and 15*l.* from an insurance office. With this money (instead of being paid to the crew), in order to ensure an efficient boat, I had one built of good size, and complete in everything for the

APPENDIX C.

WICK.

No. 184.
Medley, on Harbours, Lights, Pilots, &c.

service of piloting; and the result has been, I am informed, that she has averaged, for the crew of six men, during a season of six months, 25*l.* per man. The poverty of the pilots, and the insufficiency of the boats, arise from their being paid, as I have before stated, and sometimes not paid at all. When they board, if the tide is fair for the Firth, its rapidity is such that sometimes they cannot stop to make a bargain; and when they get through, if they will not take what is given and go on shore, they are often obliged to go on with the vessel to her destination, and get home how they can. There are several who have been taken to America; one, I know of, to Iceland; and many to various parts of England; and as these men have not branches, they cannot recover travelling expenses; their wives and families, meanwhile, are in a state of destitution, and of wretched uncertainty as to their fate. Some, again, have been paid with slips of paper, payable in various parts of England; three or four of these, under 2*l.*, I took on myself, last year, the responsibility of negociating, to assist the holder's need. Another evil from the system of paying in part money and kind, was reported to me on the 24th by a letter' to one of the crew. A man from this place took a barque through on Sunday; he was landed at Thurso with as much beef as he could carry, some tea, and 3*l.*, and in a few hours he had not a sixpence.

The system of paying from stores or cargo is an infraction of the revenue laws, and fraudulent to the owner, who probably is charged the full amount of pilotage; it is injurious to the pilot, as it naturally compels him to smuggle, and at least to sell at an under price what he obtains for his labour, under a fear of detection and punishment for a breach of the revenue laws. To prevent these evils, and to place the pilotage of the coast under legislative protection, was my object last year, observing, by the papers, that there was a Committee of the House of Commons sitting on the subject of Pilotage, but it closed its labours almost as soon as I heard of its existence. I have had the pleasure of conversing with Mr. G. Traill, late M.P. for the county, on the subject, who wished me to submit this statement, and my remarks to him, which I have declined doing, until I should find a proper opportunity of first submitting them for the honour of your consideration; that opportunity, Sir, has presented itself, by your sanction of a telegraph, thus evincing your favourable disposition towards everything promoting the interests of the commerce of the country.

The plan I would submit to remedy the evils complained of is very simple; namely, every person now practising as a pilot should be allowed his certificate of enrolment, which should be the master's guarantee for his abilities; every master should be compelled to take a pilot; tonnage, instead of draft of water, should carry pilotage; and every pilot should provide himself with blank certificates, something after the manner of those used in the navy, which the captain should sign, and any bank would negociate them; from the amount of pilotage a sum should be deducted, to form a fund to enable the rising generation (who should be compelled to serve an apprenticeship) to pay the expense of an examination, which should entitle them to a branch. Protection they have not now; consequently, when taken from their native land, they have no power to enforce travelling expenses for their return. The moral good likely to result from some plan of this kind would be obvious in a very short time; and I most sincerely trust, Sir, although this subject may not be in strict accordance with my line of duty, yet, as it bears some relation to it, its importance will be honoured with your consideration, and the motive accepted as an apology for the liberty I have taken in trespassing on your valuable time.

December 17, 1842.

As regards the Pentland Firth, I find that, in addition to what I have before stated respecting the payment of the pilots, many instances of imposition have occurred. Under the supposition that the pilots could neither read nor write, they have been called upon to make their mark to receipts for larger sums than have been paid them. Remonstrance, when such frauds have been discovered, has been useless; as wind and tide would admit of no delay, the pilots have been compelled to take the sum offered, with, perhaps, spirits, or some article of store or cargo, as a quietus. I have known 16*s.* given for pilotage, and a boat-load of coal—an article utterly useless to the poor fellows in a district where peat only is burnt. I have heard, also, of spars, bars, and various other articles, being disposed of in this way; thus a double fraud is committed—one on the owner, by charging in the ship's disbursements more for pilotage than has actually been paid; and another on the pilot, for not giving him a fair recompense for his labour, or for his risk and services combined. The revenue, too, is defrauded by the relanding of goods, and the law violated by breaking bulk; I leave out of the question the loss sustained by the owner or consignee.

These cases may appear trifling and unworthy of notice; but however limited may be the imposition in this or that individual instance, such frauds, in the aggregate, become of serious import to all parties concerned: they may also lead in some instances to grosser peculations.

My remarks, as regards an efficient system of pilotage, will be thought lightly of, I know, by those who live chiefly by the misfortunes of others: I mean that class by whom a wreck is considered a godsend.

It is to the merchant, shipowner, and underwriter I appeal; their interests are identified with those of the pilot. We have various institutions in this country connected with the saving of life from shipwreck; but if proper precaution were taken in the outset in reference to pilots, much valuable property and life might be saved, and less claim needed on the philanthropy of those excellent charities. I have now a list before me of 24 total wrecks, and of 16 vessels that have been on shore and experienced more or less damage in the neighbourhood of the Pentland Firth, within the last 10 years. Some vessels I could trace as having had pilots, but they were young men of no experience, who were taken, on the emergency of the moment, from boats when fishing.

I have, &c.,
To the Comptroller-General of the Coast Guard.
EDWARD MEDLEY, *Lieut. R.N.*,
Inspecting Officer of Coast Guard.

APPENDIX C.

WICK.

No. 285.
Stevenson, on the proposed Plan for improving the Harbour.

No. 285.

Report of MESSRS STEVENSON, *on the proposed Plan for improving the Harbour of Pulteney Town, Wick.*

Edinburgh, February 8, 1847.

ON the 18th of May, 1846, Mr. Thomas Stevenson, agreeably to arrangement, inspected the harbour of Pulteney Town, and in our report addressed to Provost Rhind, of date 13th of June, which was drawn up in consequence of that visit, we gave the following as our opinion :—

"After maturely considering the present harbour, with reference to its past history, its present state, and its situation, we are of opinion, that if the British Fishery Society have funds at disposal, sufficient to build the proposed new harbour (the plans for which we understand are about to be submitted for public contract), they cannot enter on a work more likely to improve the trade of Wick."

The harbour here alluded to was designed by Mr. James Bremner, who proposed to execute the work by means of his ingenious application of caisson building, for which he holds a patent; but as considerable doubts were entertained by the Society as to the propriety of embarking in a new and untried mode of working, our attention, on a late visit to Wick, was again directed to the state of the port, and on this occasion we were instructed by Mr. Traill, M.P., and Provost Rhind, to make out a design and estimate for the proposed new harbour, according to the usual mode of constructing such works.

In consequence of these instructions, we have very carefully reconsidered this subject, and have made the accompanying designs. The positions and directions of the piers, as laid down on Mr. Bremner's plans, cannot, in our opinion, to obtain the same amount of accommodation, be in any material degree improved. They have obviously been chosen after careful consideration, coupled with correct local knoweldge of all the bearings of the case, and we have, therefore, in our extended design, selected nearly the same site for the works referred to in this report, and delineated in the accompanying drawings, as we are of opinion that they are judiciously placed, not only for the purpose of withstanding the sea, but of preventing sand from accumulating in the new harbour; and we have, therefore, in this report only to advert to what appears to be the most advisable method of executing the works.

The bay of Wick is very much exposed to easterly gales, and its funnel-shaped outline cannot fail to increase the severity of the sea at the site of the harbour; but, while on this account it may be regarded as not favourably situated for carrying on marine works, it nevertheless possesses a most important advantage in its stone quarries, which afford materials not only of a durable nature, and in large sizes, but readily quarried, requiring little or no dressing, and capable of being easily and cheaply assembled together in the construction of piers or quay walls.

The principal difficulty experienced while carrying on the south pier of the present harbour, as stated by Mr. Bremner, was the short time (only twenty-four weeks in the year) in which the work could be prosecuted with advantage, and the impossibility in many cases of getting the building properly secured and closed in before the gales of winter or autumn should occur, when much damage was often done before almost any means (such as binding the unfinished work with chains) could be applied.

In proof of this, an instance is recorded of a gale, followed by a sudden rise of the sea, which in the course of two tides caused damage at the south pier to the amount of no less than 5,000*l.* It was the experience of such casualties that led Mr. Bremner to resort to the application of caissons. The great want which appears to have been felt, was some means of building and closing in the end of the pier in one season, or, at least, some means of depositing successive portions of the structure which should be complete and indestructible in themselves; a desideratum, indeed, to which all marine works are more or less subject. The adoption of caissons, however, for the purpose of overcoming this difficulty, though they might prove successful in some sheltered situations, is an experiment which, in our opinion, it would not be prudent for the British Society to test for the first time in so exposed a situation as that of Wick Bay.

With reference to the plans which we propose, we beg leave to refer to the accompanying drawings, in which are represented both an extended and a modified design. The extended design consists of two piers marked A. and B. respectively.

With regard to the construction of these works, it may be here stated, that though provision is made for using the diving-bell in forming the foundation of the pier heads, and also to some extent in other parts of the work, we at the same time propose that the greater part of the talus walls should be founded by dropping, or rather lowering from barges or otherwise, stones of a very large size; and should it be difficult to procure materials of the size necessary to resist the sea, we propose to use large masses, consisting of smaller stones, bored, and connected together with iron bolts, a system of building which we have lately successfully employed at Portrush Harbour in Ireland. It is also provided for in our estimate, that above low water the whole face-work of the pier shall be connected together with iron bars, somewhat like the system of treenailing frequently employed in such cases, but of a much stronger and every way of a more satisfactory description.

The stone of Wick, from its being generally thin and flat, makes remarkably strong work when it is once closed in, but when a pier of such stones is assailed while in an unfinished state by a sudden gale, the waves, as might be expected, are found to remove with great rapidity one after another of those courses, which in themselves have not sufficient weight to resist such force, but which, had they been closed in at both ends, might have for ages resisted attacks of similar or even much greater severity. With such a method of construction, however, as that proposed, which adds comparatively little to the cost, the building, we are convinced, may be carried on with greater rapidity and economy, and above all, with much greater certainty, as the danger to be apprehended, even from sudden and unexpected gales, will be greatly decreased, and the work will, from the use of such large blocks, be speedily brought above the level of low water. The estimate for both piers on this plan (exclusive, however, of the lighthouse and the communication with the present harbour), including 10 per cent. for incidents, amounts to 40,730*l.*

In the event of this estimate exceeding the funds which the Society have at disposal, we have designed and estimated, as already mentioned, a modified plan, which is also represented in the accompanying drawing. It consists of a covering pier (A.) and breakwater (C.): the estimate for this modified plan (exclusive of the communication with the present harbour) amounts, with 10 per cent. for incidents, to 33,079*l.* Were the south pier only built, we estimate its cost at 20,620*l.* In both of these designs we have shown what appears to us to be the best way of acquiring additional

No. 285.
Stevenson, on the proposed Plan for improving the Harbour.

quay room and curing stations, but on this point those engaged in the fisheries are doubtless the best advisers.

Provost Rhind having stated that the Society were desirous to undertake this work by contract, we have in consequence made application to those parties who have on different occasions executed harbours and other works according to our plans, but they were so much engrossed with extensive railway contracts, that only one of them (Mr. Barr, of Ardrossan) had any prospect of being able to engage in that for Pulteney Town. We may however mention, that in conducting operations in exposed situations, we have generally found the appointment of an intelligent and vigilant superintendent, having the charge of men paid by the day, a more satisfactory mode of proceeding than that of entering into a contract; to cover the risk attending which, the contractor must necessarily add to his offer a high rate of per centage for incidents, and among the harbour works now or lately carried on under our superintendence, we may mention Ballyshannon, Hynish, Portrush, and Lord Palmerston's Harbour at Mullaghmore, all of which have been carried on successfully and economically, without entering into contracts.

THOMAS STEVENSON.

To the Governor, Deputy Governor, and Directors of the British Fishery Society.

No. 286.

MR. ALEXANDER M'PHERSON, *Lloyd's Agent, on the state of the Harbour.*

No. 286.
M'Pherson, on the state of the Harbour.

September 24, 1846.

I HAVE the honour to acknowledge the receipt of your favours of the 16th and 19th inst. I have given your communications the best consideration in my power, and after mature reflections, I have no hesitation in saying that I think the passing of such an Act as the Bill you transmitted would have a most beneficial effect. My opinion is formed principally with reference to the harbour of Pulteney-town, which is the port of Wick. That harbour is under the exclusive management of the British Fishery Society. The Society have, no doubt, a considerable stake in the prosperity of the harbour, but that stake is trifling compared with the stake which the feuars and inhabitants of Pulteney-town and Wick have in it, by whose trade it is exclusively supported. Those locally interested in the harbour do not think that everything is done which might easily be done to make the harbour available for the trade of the place. No doubt, two years ago the Society applied for and got an Act for making an extended harbour, but although contractors were advertised for, none have as yet been obtained. In the mean time nothing has been done for the old harbour, the inefficient state of which rendered the new one necessary. At its formation, a number of stones were left at the mouth of the entrance; these have always been an annoyance, and dangerous to vessels entering or quitting the harbour, and particularly loaded vessels; and latterly have formed a bed for an accumulation of sand, whereby the depth of water at the entrance has been considerably diminished.

From anything I can see there is no immediate prospect of the new harbour going on; but this only renders it the more necessary that something should be done to improve the old one; and I think much could be done in this way by removing the stones complained of, and then clearing out the sand at the mouth and inside of the harbour by dredging, which I consider perfectly practicable, and which, in my opinion, could be done at no great expense; scientific men, however, are the best judges of this. These are local matters; but the appointment of a Board, acting over the whole kingdom, administered with energy by competent persons, would in all probability tend to remove all local grievances, and most likely have a beneficial effect.

A. M'PHERSON.

No. 287.

Return of Income and Expenditure for the Years 1841–2–3.

No. 287.
Income and Expenditure.

INCOME.				EXPENDITURE.			
Heads of Income.	1841	1842	1843	Heads of Expenditure.	1841	1842	1843
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Tonnage dues	252 10 4	205 18 8	265 13 0	Salaries and allowances	169 0 0	156 0 0	145 5 0
Imports and exports, &c.	626 7 6	696 14 3	803 19 9	Clearing harbour of sand	85 0 0	177 2 1	104 6 8
				Materials for and repairs to quay, harbour and roadways to same	369 3 0	489 6 0	707 2 5
				Lighter, cranes, and weighing machine, &c.	..	292 5 9	12 13 0
				Plans of the proposed new harbour	..	25 0 0	36 15 0
				Rent of office, and to Duke of Sutherland, as superior of Wick	50 0 0	50 0 0	48 16 8
				Incidental expenses, and interest	18 13 0	28 8 9	22 14 2
Total . £	878 17 10	902 12 11	1069 12 9	Total . . £	681 16 0	1218 2 7	1077 12 11

Dues levied under Act of 1814, and a subsequent Act, 7 and 8 Victoria, c. 52.
Rate of tonnage:—
Vessels between 15 and 45 tons, 2*d*. per ton.
Ditto above 45 „ 4*d*. „
The cost of the construction of the harbour was about 45,000*l*.

SAMUEL SMITH, *Secretary.*

Debt due on the 1st of January, 1846, 5,227*l*.

No 288.

List of Wrecks in Sinclair Bay, Caithness.

Date.	Name.	Rig.	Belonging to	Where from	Bound to	Cargo.	Wind.	Weather	Where wrecked	No. of Lives lost.	Remarks, &c.
April, 1840	Percy	Brig .	Sunderland	Sunderland	America	Coal . .	S.E.	Strong breezes .	Keiss Sands	. .	Got off and taken to Wick.
. .	John . . .	,,	Londonderry	Londonderry	Baltic .	General .	S.				
26 Oct.	Cleofrida . . .	,,	Newcastle .	Cronstadt .	Liverpool	Tallow and Hemp.	E.S.E	Light and hazy	Skerza Head	.	Got off by Coast Guard with rudder unshipped, and taken to Stromness
„ 1841.	Electra	,,	Dundee .	Riga . .	Belfast	,,	S.E	Fresh breezes .	Keiss Sands	. .	Got off and repaired.
. .	Valiant . .	Bark .	Memel .	Memel .	Liverpool .	Timber .	,,	,,	,,	.	Got off, obliged to run to Stromness and unload
2 July, 1842.	Amity	Smack	Gravesend .	Gravesend .	Fishing .	Fish . .	,,	Light breezes and hazy	,,		Total wreck.
13 May, 1843.	Thomas and Elizabeth	Schooner	Yarmouth ,	Newcastle .	Dublin .	Coal .	,,	Strong breezes .	,,	.	Total wreck
15 Aug.	Unknown . . .	Sloop .	,,	Ireland	,,	Salt . .	,,	Light breezes .	,,	.	Got off and repaired.
10 Sept.	Regatta	Brig .	Belfast .	Cronstadt .	Belfast .	Tallow, &c	,,	Moderate and hazy	,,		Stranded, but got off
24 Feb. 1844.	Ruby	Sloop .	Aberdeen .	Aberdeen	Loch Mordart	Salmon Fishing Gear	,,	Gale and snow storm	Freswick	2	Total wreck
3 Sept.	Sarah	Schooner	Isle of Man	Liverpool .	Berwick .	Guano & Salt	,,	Light winds and hazy	Rock of Freswick	. .	Stranded, but got off
10 Oct	Venus	. .	Port-a-Ferry	Dunbar .	Dublin .	Herrings	,,	Strong gale . .	Keiss Sands	4	Total wreck.
15 Nov.	Advice	. .	Sunderland	Brora . .	Thurso	Ballast . .	,,	Ditto, with rain.	Freswick Bay	. .	Got off, much damaged
1 June, 1845.	Minerva	Bark .	Glasgow .	Hull .	Quebec .	,,	S.	Strong . .	Keiss Sands	.	Got off, much damaged
30 Sept.	Lady Panmure . .	Schooner	Dundee	Wick .	Bristol . .	Herrings .		Moderate . .	.	.	Got off, much damaged.

Note.—The above are the names of vessels lost, or grounded, between Noss and Skerza Heads, which form the extreme points of Sinclair's Bay, on this coast, exclusive of a great number of vessels that have been embayed, and were close upon Keiss Sands, ere their mistake was discovered, and then only in time, by nerve and seamanship, has shipwreck been avoided.

Lieutenant, R N., Inspecting Officer of Coast Guard Station

APPENDIX C.

ACKERGILL.

No. 289.
Medley, on the want of a Pier at Ackergill.

ACKERGILL.

No. 289.

Lieutenant MEDLEY, R.N., *Inspecting Officer of Coast Guard, on the Harbours of Wick and Broadhaven, and the want of a Pier at Ackergill.*

SIR, *Staxigo by Wick, Caithness, October* 30, 1846.

IN compliance with Captain Washington's directions, I herewith transmit extracts of my various correspondence, embracing the subjects of lighthouses, harbours, and pilots, or their system, and, in connexion with it, a list of shipwrecks, for the information of the Commissioners of Tidal Harbours.

You will be pleased to state that, since the Commissioner's visit to Wick, I have had an opportunity of witnessing the effects of a south-east gale on Broadhaven. I have had the opinion of the superintendent of the works of the pier being built in Thurso Bay, and that of the officers of the *Sovereign* steam-packet: all agree as to the capabilities of Broadhaven, with a trifling outlay, as an auxiliary to Wick; vessels could land there when they could not approach Wick; any outlay on Wick is merely speculative and lost.

On the 5th, 7th, 14th, and 15th instant, three different steamers attempted Wick with the wind from south to south-east, and were obliged, together with two sailing-vessels, to run for shelter in Sinclair Bay. Ackergill, in this bay, is the place where goods and passengers are landed when Wick cannot be approached; and at this place it would be most desirable that a pier harbour should be erected. The bay is extensive, has excellent anchorage, and I have counted more than 40 sail of vessels, some at anchor, and some standing off and on, during the prevalence of westerly gales preventing their going through the Pentland Firth; and the wrecks on Keiss Sands show the necessity of a pier harbour. The Commissioner had the opportunity of seeing the site of the proposed pier at a very low spring tide; and all that know the place concur with my opinion as to its eligibility for a pier harbour. If one-fourth of the money were expended at this place that has been laid out on Wick, a pier might be erected with 2½ fathoms at its head at low water.

I am aware, Sir, that I am attacking powerful local interests, but I have been very nearly seven years on this coast, and I well know the habits and manners of the people, and I fear that self is a more powerful principle than public advantage; but where unfettered opinions are given, they are given in favour of Sinclair Bay and Broadhaven.

The lighthouse on Noss Head having been decided upon, I shall offer no remark, except the recommendation of its having a gong for hazy weather, as the land is precipitous and bold, in which opinion the Commissioner concurred.

Of the pilots of this coast I can offer no further remarks than I have already done in the accompanying papers under that head; not a year passes without abuses of the present system; I know more, and I hear more, since residing at this place, than I could possibly know or hear at Freswick; and I can only express my sorrow and regret, that persons glorying in the proud name of British merchant and shipowner, should be guilty of the meannesses I know of toward this poor hard working class of men. I have never known but one generous act towards the pilot, which I hope I shall be excused relating. I forwarded a pilot-order to Mr. Coutts, an iron shipbuilder, of Newcastle-on-Tyne; he was at Liverpool when my letter arrived at his residence; it was forwarded to him; he very generously added to the amount to compensate the poor man for any inconvenience he might have sustained by the delay occasioned through his absence from home.

I hope, Sir, the observations I have made in the accompanying papers may be found, if not in all, in some respects useful. I have done what I conceived to be my public duty as a naval officer; I know my interference with evils that do and have existed for years has drawn upon me much obloquy, but to that I am indifferent, if in the end a public good is achieved, and I have the approbation of generous minds.

I have, &c.,
EDWD. MEDLEY,
Lieut. R.N. Inspecting Coast Guard.

The Secretary,
Tidal Harbours Commission.

KIRKWALL.

No. 290.
Return to Order of House of Commons of 9th Aug., 1846.

KIRKWALL.—ORKNEY.

No. 290.

Return to Order of the House of Commons of August 9, 1844.

SIR, *Custom House, Kirkwall, February* 15, 1845.

IN obedience to your letter of 1st instant, I humbly beg to state, that the barbour of this port is managed by twelve trustees, appointed under the Act 9 Geo. 4, cap. 58, "An Act for maintaining, enlarging, improving, and regulating the Harbour of the Burgh of Kirkwall, in Orkney, 23rd May, 1828." Under this Act alone the trustees have acted, and now act.

There are no maps of the harbour or port in the possession of the trustees, nor any reports made by engineers or other officers respecting the port or barhour; nor are there any complaints made to the trustees of the harbour or port, of the defects of the same.

I have, &c.,
ROB. LOUTIL, *Collector.*

Hon. H. Manners Sutton,
&c. &c. &c.

APPENDIX C.

KIRKWALL.

No. 291.
Income and Expenditure.

No. 291.

Return of the Income and Expenditure for the Years 1841-2-3.

INCOME.										EXPENDITURE.									
Heads of Income.	1841			1812			1843			Heads of Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Tonnage and cargo dues	120	0	0	146	0	0	156	0	0	Expenses of management	7	10	0	7	10	0	7	10	0
										Improvements and clearing . . .	58	0	0	17	1	3	12	13	1
										Towards payment of debt	8	7	6	77	5	3	94	15	0
										Interest on debt .	46	2	6	44	3	6	41	1	11
										Total . . . £	120	0	0	146	0	0	156	0	0

Dues levied under Act 9, Geo. IV., c. 58.

ROBERT LOUTIL, *Collector.*
GEORGE FIRTH, *Comptroller.*

Debt due on the 1st of January, 1846, 779*l.*

LERWICK.

No. 292.
Return of Dues levied on Shipping for the years 1843-44.

LERWICK.—SHETLAND.

No. 292.

Account of the Total Amount of the several Dues and Charges of every kind levied on Shipping at this Port, in each of the years 1843, 1844.

Date.	Harbour Dues.						Local Lights and Beacons.	Pilotage.	Ballast.
	British Vessels.			Foreign Vessels.					
	£.	s.	d.	£.	s.	d.			
1843	21	10	0		..		Nil.	This it is impossible to ascertain, as there are no records kept, nor are there any means by which the amount could be known. The pilots are neither licensed nor their number known. Every fisherman who is competent is a pilot.	This, too, there are no means of knowing, as there is no ballast belonging to the Corporation, or any public body, but it is obtained privately in the way parties best may.
1844	18	14	0		..				

It is to be observed that the above are merely the amount of the dues and charges levied on those vessels which take advantage of a harbour belonging to private individuals here. Such vessels form a mere fraction of the whole number coming to this port, and which pay no harbour dues whatever, as they lie and discharge in the roadstead of Brassay Sound.

R. S. KILGOUR, *Collector.*
F. HEDDELL, *Comptroller.*

Custom House, Lerwick, 5th May, 1845.

No. 293.
Kilgour, on the neglected state of the Harbour.

No. 293.

MR. R. S. KILGOUR, *Collector of H. M. Customs, on the neglected state of the Harbour.*

December 1, 1846.

OUR harbour is the natural one of Brassay Sound, and a most capacious and admirable roadstead it is. To vessels proceeding to or from Russian ports in the White Sea, Norway, Iceland, or the north of Europe generally, it is of great importance as a place of refuge, and in this respect it was of much use to our ships-of-war when cruising in the North Sea during the war. I myself have often seen more than a hundred vessels at one time lying in it, including ships-of-war, merchantmen, and fishing vessels. Yet there seems all along to have been a want of attention paid to it; there is no public pier or landing place, and neither are there buoys nor lights, although all these would be most useful; and the inhabitants of Lerwick have encroached and built into the Sound as they found convenient. About 24 years ago the Lord Advocate, at the instance of the Commissioners of Customs, raised an action of reduction, declarator, and removing against a party who had erected a jetty and other buildings within high-water mark, and evicted these from him; and at same time published a general prohibition and interdict against all future encroachments, which however, I believe has not been strictly attended to. Indeed it is only within these few months that I had to republish this prohibition in consequence of a contemplated encroachment.

R. S. KILGOUR, *Collector.*

CASTLEHILL.

No. 294.
Return to Address of the House of Commons of 29th July, 1844.

CASTLEHILL.

No. 294.

Return to Address of the House of Commons of July 29, 1844.

Castlehill, by Thurso, January 31, 1846.

SIR,

I AM directed by George Traill, Esq., of Rathe, as his factor, to make the following return relating to the harbour here.

The harbour is private for the accommodation of Mr. Traill's estate; was erected solely at the late Mr. Traill's expense; and no dues are exacted, nor is there any expenditure except casual repairs.

I am, &c.,
JAMES PURVIS.

The Hon. Manners Sutton.
&c. &c. &c.

THURSO.

THURSO.

No. 295.

Return to Order of the House of Commons of 9th August, 1844.

No. 295.
Return to Order of the House of Commons of 9th Aug. 1844.

Thurso, April 1, 1845.

SIR,

IN reply to your letter of the 1st of February last, I beg to state that there is no Act of Parliament,* charter, or commission for said harbour, under which any commissioners or other persons are appointed to act; nor is there any map or plan of the harbour. The harbour is merely a river one, to which the access is regulated by the flowing of the sea-tides. The only management had is by the person who collects the paulage-dues of 1*d*. per ton for vessels entering the harbour, from which dues the pauls are furnished, and there have been no complaints against that person.

I may further state that the want of a suitable harbour at Thurso has been long felt to be a serious disadvantage to the place and the adjoining district of the county; and that in the bay of Thurso, at Scrabster, works are in progress for the erection of a harbour, in virtue of an Act of Parliament, to which the Royal assent was obtained on the 21st of June 1841, intituled "An Act for making and maintaining a Harbour at Scrabster Roads, in the Bay of Thurso and County of Caithness, and Road thereto;" but, as above mentioned, the works are only in progress.

I have, &c.,
WM. ANSON.

Hon H. Manners Sutton,
&c. &c. &c.

No. 296.

Return of Income and Expenditure for the Years 1841–2–3.

No. 296.
Income and Expenditure.

INCOME.										EXPENDITURE.									
Heads of Income.	1841			1842			1843			Heads of Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Paulage dues . .	11	6	5	13	19	0	16	14	10	Salary to harbour-master	2	0	0	2	0	0	2	0	0
										Clearing harbour of sand, and deepening river	3	10	0	23	15	0	18	0	0
										Sinking dolphin and floating buoys, and placing pauls, &c. .	13	2	3½	2	10	0	6	0	0
										Total . £	18	12	3½	28	5	0	26	0	0

"Use and wont." The present excess of expenditure has been met by a loan.

(No Signature.)

SCRABSTER.

No. 297.

The Report of MESSRS. STEVENSON, C.E., *on Scrabster Pier and Harbour.*

SCRABSTER.

No. 297.
Stevenson, on extending the Pier.

Edinburgh November 9, 1847.

ON several occasions, during the progress of the pier works now being executed under our direction at Scrabster, we have been called on to state to the trustees our opinions as to the roadstead and harbour, and our original design for the low-water pier being now nearly completed, and a further extension of the work being proposed, our opinion has been requested as to the projected work. Before noticing the particular plan, we think it necessary to repeat generally our views as to the roadstead and harbour, for the purpose of showing its importance, and guarding the trustees against adopting, with the view of saving expense, such an extension of the works as they might at some future period see reason to regret.

Scrabster Road, in the county of Caithness, forms part of what is termed the Bay of Thurso. This bay is situated at the western entrance of the Pentland Frith, which is well known to be one of the most hazardous and difficult navigations in the United Kingdom, and yet forms the natural northern outlet from the German Ocean and the Baltic to the Atlantic. The trustees are no doubt aware that it was the danger attending the navigation by the Pentland Frith and Cape Wrath, which in a great measure induced the Commissioners for the Caledonian Canal to recommend the execution of that great national work in terms of the opinion and advice of the late Mr. Telford, who in his Report of 15th March, 1803, states that "he had examined experienced and well-informed mercantile and seafaring people with regard to the navigation by the Pentland Firth and the Orkneys, and that he had found but one opinion as to the dangers and inconveniences of that navigation, and the advantages which might be expected from the proposed canal." Notwithstanding these dangers, however, the navigation is very much frequented by shipping, which from the establishment of Pentland Skerries, Dunnethead, and Cape Wrath lighthouses, can now take the passage with much greater comfort and safety than formerly. The situation of Scrabster, as the only harbour of refuge on the southern coas

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* An Act, 42 Geo. III. c. 112, was obtained for building and maintaining a harbour and pier at the town and in the parish of Thurso, in the county of Caithness, by which 24 persons named in the Act were incorporated by the name and style of the Thurso Harbour Company, with the usual powers to levy rates, borrow money, &c., but it does not appear that it has ever been acted upon.—ED.

APPENDIX C.

SCRABSTER.

No. 297.
Stevenson, on extending the Pier.

of this dangerous and much-frequented passage, renders its roadstead of much importance, and it is natural that its improvement should be a subject of deep interest and solicitude to the harbour trustees, and that the nature and tendency of any extension of the works should therefore be duly weighed before being entered on. As a proof of the repute in which the harbour even in its natural state is regarded by seamen, we may mention that at the time of our visit to the works, on the 21st of May last, there were 21 vessels lying at anchor in the bay; and the chief boatman at the Coast Guard station, on referring to his books, informed us that within the last five years he had boarded upwards of 1800 vessels which had come to an anchor in the roads, either for shelter or to await favourable winds.

The entrance to Thurso Bay, in which the roadstead is situated, is about six or seven miles wide between Hobborne Head on the west, and the land of Dunnethead on the east, where one of the northern lighthouses is situated. The safest anchorage is at a place called the Rings of Scrabster, "which is under the lee of the Little Head," and were a breakwater projected from the Head it would increase the security and extent of the anchorage ground, and be regarded as a great boon by the shipping frequenting the coast. The funds at the disposal of the trustees, however, are so limited as hitherto to have prevented them from seriously entertaining the idea of entering on works of such magnitude; and we have therefore at present to describe briefly the works which they have executed, and the additional works desired for the further accommodation of trade, and to give our opinion as to the extent of these additional works, and the manner in which they ought to be carried out.

The plan originally proposed and specified, and which is now nearly completed, consists of a low-water pier extending from a point on the shore called the Salmon-house, measuring 100 feet in length, and having a slip on its eastern or sheltered side for the purpose of shipping cattle. The limited length of 100 feet was proposed, in the first instance, from a desire not to exceed the funds at the disposal of the trustees; and, considering the difficulty of ascertaining the extent to which the quarrying operations might have extended before a sufficient supply of suitable materials were obtained, as well as the uncertainty of founding in such a situation below low water, it was thought prudent not to adopt a greater length in the first instance. The excellent quality of the stones however produced by the quarries, and the comparative ease with which they were obtained, as well as the complete success which has attended the means adopted by Mr. Downie, the resident inspector, for founding and carrying on the work, have combined in reducing the expense and enabling the trustees to carry the work a little further out. The pier, as already stated, is 100 feet in length, and at its extremity has a depth of 13 feet at low water of spring tides.

The addition which the trustees are desirous to make, consists of a kant, or return head, of 50 feet in length, extending from the point of the present pier, which projects from the shore nearly at right angles; and such a work it is presumed will absorb the whole of the funds at their disposal. This addition would afford considerable shelter, and in that respect would no doubt be beneficial; but we are decidedly of opinion that it would be inexpedient to form the kant from the present termination of the pier, as the accommodation and future utility of the harbour would thereby be greatly impaired; and we have therefore, in conclusion, briefly to offer our views as to the most prudent course for the trustees to pursue in carrying out their future operations.

We have ascertained that the Sovereign steamer, which visits the coasts of Caithness on its way to Orkney, measures 167 feet 6 inches in length over the rails, and it is evident that the introduction of a kant at the termination of the present pier would render the harbour, if not inaccessible, at least highly inconvenient for a vessel of that size. We therefore think that this circumstance alone is a sufficient ground for determining that the present pier ought to be carried out farther in the same line, before any kant is introduced. We have, in connection with the future extension of trade, carefully considered the length to which it ought to be projected, and we send herewith a plan showing what we propose, which is, to carry out the existing pier 100 feet further in its present direction, and to form at the extremity a kant, at an angle of 50° with the line of its face, and 50 feet in length. We have estimated the cost of this work, which, in the absence of soundings specially taken for the purpose, we are of opinion may be executed for the sum of 2,400*l*. Although this sum may exceed the funds at the present disposal of the trustees, we are nevertheless of opinion that the importance of Scrabster as a harbour, and the facilities which exist for the formation of the low-water pier, suited for vessels of a large class, would render it very inexpedient to adopt any modified plan which might permanently injure the utility of the work. We are the more especially disposed to recommend continuing the present line of pier, as in the event of a breakwater being projected from the Little Head, the works now in progress would still form the landing-wharf for the shipment of goods. We are not aware of any artificial harbour on the east coast between Scrabster and Peterhead which can claim, from its superior, or even equal, depth at low water, the same public importance; and we should, therefore, caution the trustees against entering upon any half measure which would destroy, or even curtail, the numerous advantages which such a situation holds out for the shipping frequenting the northern coasts of Scotland.

I have, &c.,
THOMAS STEVENSON.

To the Trustees of Scrabster Harbour.

STORNOWAY.

No. 298.

STORNOWAY.

No. 298.
Return to Order of the House of Commons of 9th Aug., 1844.

Return to Order of the House of Commons of August 9, 1844.

SIR, *February* 13, 1845.

I HAVE to acknowledge the receipt of both your circulars of date the 16th November and 1st instant.

In answer to the first of these, I beg leave to state that, for upwards of four years past, the vessels belonging to the inhabitants of this place paid no dues whatever when they came to the quay, the same having been built from subscriptions made by them, but vessels which came to the quay belonging to other ports paid dues at the rate of 1½*d.* per ton of their register tonnage.

APPENDIX C.

STORNOWAY.

No. 298.
Return to Order of the House of Commons of 9th Aug. 1844.

And the *only* authority under which these dues were so levied was by an order of a committee of the subscribers.

I have further to state, in answer to the circular of the 1st inst., that I am not aware of any authority under which dues are levied except that already stated; and I have no maps of the harbour or port of Stornoway in my possession, nor am I aware of any reports made by engineers or other officers relative thereto.

I am, &c.,
ROD. MACKENZIE.

The Hon. H. Manners Sutton,
&c. &c. &c.

No. 299.

Answers to Printed Queries relative to the Harbour, by Professor LEWIS GORDON, C.E.

1847.

No. 299.
Answers to Queries.

STORNOWAY lies in a deep bay on the east coast of the island of Lewis, and has an area of 160 acres, or a quarter of a square mile, of anchorage, remarkably sheltered from all save S.S.E. winds, with a general depth of from four to five fathoms water, on a bottom of sand and mud. Ordinary spring tides rise 15 feet, neaps to 11 feet; neap tides range 5 feet 8 inches, extreme tides 17 feet. The stream of tide does not exceed two knots an hour. There are about 2000 feet of quay walls built of mica schist, and one building slip, and a patent slip for a vessel of 800 tons is in course of being laid down. Supplies of water and provisions are plentiful, and coal at 20*s.* a-ton. Population 3227. Sixty sailing-vessels of 3290 tons, and one iron steamer of 110 horse power belong to the place. The arrivals are 103 coasters and 12 foreign—total 336, including wind-bound and those seeking shelter, as vessels of all nations take this port for shelter in their passage through the Minch. An Admiralty survey of the bay was completed by Captain Otter, R.N., in 1846. Designs for improvements have been made by Messrs. Gordon and Hill, C.E., of Glasgow, and by Mr. Moffatt, C.E., of Ardrossan. Low-water piers are in course of erection at the expense of the proprietor, and the inner harbour will probably be dredged. Quay dues, 20*l.* in 1845–6.

No. 300.

Return of Income and Expenditure for the Years 1842–3–4.

No. 300.
Income and Expenditure.

INCOME.				EXPENDITURE.			
Heads of Income.	1842	1843	1844	Heads of Expenditure.	1842	1843	1844
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Tonnage dues 1½*d.* per ton	1 18 3	4 2 5	14 5 10	..	..	..	..

The quay of Stornoway was built by subscription of the inhabitants, in consequence of which none but vessels belonging to other ports paid tonnage dues.

ROD. MACKENZIE.

TOBERMORY.

No. 301.
Return to Address of the House of Commons of 29th July 1844.

TOBERMORY.

No. 301.

Return to Address of the House of Commons of July 29, 1844.

	£	s.	d.
Amount of quay-dues received in the year ending 31st December 1841, from vessels under 45 tons, and vessels above that tonnage . .	£14	2	1
Ditto, year 1842	14	6	10
Ditto, year 1843	11	4	3

	£	s.	d.
Expenditure in year 1841 . .	£11	5	6
Ditto, year 1842	10	6	6
Ditto, year 1843	10	5	6

By authority of Act of Parliament.

NO SIGNATURE.

OBAN.

No. 302.
Return to Address of House of Commons of 29th July, 1844.

OBAN.

No. 302.

Return to Address of the House of Commons of July 29, 1844.

Oban, March 18, 1845.

	£	s.	d.
QUAY dues from 1st January till 31st December, 1843, both inclusive, .	£34	11	9
Disbursements during same period	8	6	5
	£26	5	4

The registered tonnage of the vessels having been taken without particularly distinguishing the items of a general cargo, it is impossible to state the amount of income under each head.

The dues are charged for loading and discharging at the quay, the private property of the Marquess of Breadalbane, the proceeds from which have hitherto gone to improve and enlarge the pier.

The writer took charge only at the above time, consequently can give no information for the years 1841 and 2; but may state, that he does not think any account was kept previous to the year 1843.

The income chiefly arises from the importation of meal, coal, and general merchandise from Glasgow, Liverpool, and Belfast; wool, potatoes, &c. to Liverpool and Glasgow; landing sheep and cattle from the Western Islands; steamers to and from Glasgow, Inverness, and the Western Islands; and vessels taking shelter in stormy weather.

The charge is only 1*d.* per ton on coal, stone, brick, slate, &c., and 2*d.* per ton upon wool, meal, potatoes, &c.

Authority for collecting—the Marquess of Breadalbane.

DUNCAN MCARTHUR,
Collector of Quay Dues.

The Honourable H. Manners Sutton.

APPENDIX C.

ARDRISHAIG and CRINAN.

No. 303.
Return to Order of the House of Commons of 9th Aug. 1844.

ARDRISHAIG AND CRINAN CANAL.

No. 303.

Return to Order of the House of Commons of August 9, 1844.

May 14, 1845.

Title of Act:—

AN Act for making and maintaining a navigable Canal from Loch Gilp to Loch Crinan in the Shire of Argyle, 1793.

The property of the canal held by the Treasury, and management of the canal in the hands of the Commissioners of the Caledonian Canal since 1817.

Maps:—

A map of the harbour of Ardrishaig as it at present exists accompanies this, and reference made thereto.

Reports made by Engineers, &c., and Complaints made, &c.

The queries under this head cannot be so satisfactorily answered by quotations and reference to special reports and complaints, from their desultory nature, mixed up with canal matters over a course of years, and from complaints being for the most part verbal, as by a short statement of the present circumstances of the harbour of Ardrishaig, as exhibited in the accompanying plan, and of the entrance at Crinan.

Ardrishaig.—This harbour is necessary to afford shelter to vessels entering and departing from the Crinan Canal: it is also much frequented during the fishing season by the Lochfyne fishing-boats, and has become the most important steam-boat station on Lochfyne, either as regards the steamers or the country with which it communicates—and for these united purposes it is justly complained of as very defective in point of extent and wharfage accommodation, &c., the obvious correction of which appears to be an extension of the breakwater, and forming a wharf-wall, &c., along the inside thereof, together with deepening the harbour. Formal complaints of defective accommodation in this harbour lie before the Commissioners for the Caledonian Canal.

Crinan.—The western extremity of the canal at Crinan, besides being the departing and entrance harbour at the western extremity of the canal, has become a station of growing importance for steamers to the west Highlands, communicating with the steamers which frequent Ardrishaig from the Clyde by means of the Crinan Canal, &c., and is no less defective than Ardrishaig both for protection and wharfage, for which a breakwater affording ample shelter and wharfage-ground to vessels departing from and entering the canal is very much required.

WILLIAM THOMSON, *C.E.*

Hon. H. Manners Sutton,
&c. &c &c.

No. 304.
Income and Expenditure.

No. 304.

Return of Income and Expenditure for the Years 1841–2–3.

INCOME.

Heads of Income.	1842			1843			1844		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
ARDRISHAIG HARBOUR:									
Harbour dues upon steam-boats . .	325	4	8	394	5	10	277	6	11
Ditto Fishing and other vessels .	11	10	10	8	8	0	10	19	10
Quay or wharf dues, 1d. per ton . .	22	17	9	26	14	5	19	11	8
	359	13	3	429	8	3	307	18	5
CRINAN HARBOUR:									
Harbour dues upon steam-boats, at 1*d.* and 2*d.* per ton .	39	0	2	42	18	4	45	2	4
Quay or wharf dues, at 1*d.* per ton . .		..			..		0	11	0½
	39	0	2	42	18	4	45	13	4½
Total, Ardrishaig and Crinan . . .	398	13	5	472	6	7	353	11	9½

EXPENDITURE.

Heads of Expenditure.	1842			1843			1844		
	£.	s	d.	£.	s.	d.	£.	s.	d.
Salary of harbour-master and incidents	44	18	4	40	17	3½	43	14	6½
Repairs and improvements	41	1	5	127	18	3	7	4	4
Pier-head light . .	29	10	4	21	13	8	21	8	0
On account of debt, with interest . .		..			..		204	15	5
Tower for new light .		..			..		65	2	7
	115	10	1	190	9	2½	342	4	10½
New wharf wall, and wharf for steam-vessels		..		408	8	3½	15	10	0
Incidents . . .	0	11	10	0	9	3		..	
Deepening harbour .		..			..		66	8	6
	0	11	10	408	17	6½	81	18	6
Total, Ardrishaig and Crinan	116	1	11	599	6	9	424	3	4½

Dues are levied under Commissioners for Caledonian Canal under Crinan Canal Act.

Amount of debt contracted for building steam-boat pier, in 1836, (with interest) to 31st December, 1844, 1,521*l.* 0*s.* 6*d.*

The close connexion which the harbours at Ardrishaig and Crinan have with each other in their connexion by the Crinan Canal, and their receipts and expenditure being commixed with the canal accounts, render it necessary to exhibit them together.

WM. THOMSON.

Debt due on the 1st January, 1846, 1591*l.*

APPENDIX C.

CAMPBELLTOWN.

CAMPBELLTOWN.

No. 305.

Return to Order of the House of Commons of August 9, 1844.

No. 305. Return to Order of the House of Commons of 9th Aug. 1844.

SIR, *February* 7, 1845.

I AM desired by the magistrates of the town to say in answer to your letter of the 1st instant, that Campbelltown was erected into a royal burgh by charter of erection dated 19th April 1700, and sealed at Edinburgh the 1st day of July thereafter, and that it is under this charter the magistrates now act.

This is the only document with reference to what is required which the magistrates have.

I am, &c.,
NATHANIEL HARVEY, *Town Clerk.*

The Honourable H. Manners Sutton,
&c. &c. &c.

No. 306.

Return of Income and Expenditure for the Years 1842-3-4.

No. 306. Income and Expenditure.

INCOME.

Heads of Income.	1842 £.	1842 s.	1842 d.	1843 £.	1843 s.	1843 d.	1844 £.	1844 s.	1844 d.
Sale of anchorage and shore dues, and proceeds of weigh-house	153	14	6		..			..	
Sale of anchorage and weigh-house dues .		..		105	0	0		..	
Sale of anchorage, ballast, and weigh-house dues . . .		..			..		125	0	0
Harbour dues . . .		..		17	5	8	16	17	0
Sale of sea-ware . .	7	18	0	6	15	0	6	0	0
Ballast and Cranage .		..		21	12	5		..	
Total . . £	161	12	6	150	13	1	147	17	0

EXPENDITURE.

Heads of Expenditure.	1842 £.	1842 s.	1842 d.	1843 £.	1843 s.	1843 d.	1844 £.	1844 s.	1844 d.
Salaries of officers of town and harbour	*78	8	0	79	5	0	61	18	0
Repairs	29	11	3	130	14	7	77	19	10½
Cost of harbour light	27	11	2½	30	12	8	29	2	4
Lighting streets and quays. . . .	*98	12	10	92	18	8	96	3	2½
Law expenses, on account of dues disputed . . .	142	14	11		..		400	0	0
Total . . £	376	18	2½	333	10	11	665	3	5

Dues are levied under Charter of Burgh.

* The accounts of these items for the town and harbour cannot be distinguished.

JOHN CORVILL, *Provost.*

Debt due on the 1st January, 1846. 1395*l.*

EAST TARBERT.

EAST TARBERT.

No. 307.

Return to Order of the House of Commons of August 9, 1844.

No. 307. Return to Order of the House of Commons of 9th Aug. 1844.

SIR, *February* 10, 1845.

IN compliance with your official letter to me of February 1 current, I have the honour to make the following return:—

1. The title of the Act of Parliament under which I have acted, and now act, is, "An Act for Erecting a Harbour or Quay at East Tarbert in the Shire of Argyll."—Anno 6 Annæ Regin. No. 33.

2. There are no maps of the harbour or port of Tarbert in my possession.

3. There are no reports made by engineers or other officers, respecting the harbour or port, in my possession.

4. No complaints have been made of defects of the said barbour.

The above-mentioned Act of Parliament had been lost sight of for many years previous to 1823 and had consequently not been acted upon: in 1809 and subsequent years considerable works were executed in the harbour at the joint expense of the Parliamentary Commissioners of Highland Roads and Bridges and myself. The engineer's report and plan of the harbour will probably be in the possession of the Commissioners. I had a sketch of the plan made by the engineer, Mr. James Hollingsworth, then resident engineer of the Crinan Canal, but it has been mislaid, and, notwithstanding a thorough search for the purpose of forwarding to you a copy of it, I have been unable to find it. I have a small plan of the lands contiguous to the harbour, which shows the configuration of the creek which forms it, but none of the works except the situation of the old jetty, which was the only one previous to 1809. If desired, I will cause a copy of that part of the plan to be made and forwarded to you.

Since the works executed at the joint expense of the Parliamentary Commissioners and myself an additional quay has been erected for the accommodation of steam-boats.

I have, &c.,
JOHN CAMPBELL.

The Hon. H. Manners Sutton,
&c. &c. &c.

APPENDIX C.

EAST TARBERT.

No. 308.
Income and Expenditure.

No. 308.

Return of Income and Expenditure for the Years 1841–2, 1842–3, 1843–4.

INCOME.										EXPENDITURE.									
Heads of Income.	1841-2			1842-3			1843-4			Heads of Expenditure	1841-2			1842-3			1843-4		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d	£.	s.	d.
Dues upon sailing vessels	37	9	11	36	18	10½	41	8	2	Repairs and fenders	103	10	10	95	18	11½		..	
Ditto upon steam vessels	67	9	0½	76	8	6	86	2	6	Salaries of harbour-master and clerk	26	0	0	26	0	0	26	0	0
Total . . £	104	18	11½	113	7	4½	127	10	8	Total . . £	129	10	10	121	18	11½	26	0	0

Dues are levied under Act 6 Anne, No. 33.

JOHN CAMPBELL, *Proprietor of Tarbert.*

KILMORY—LOCH GILPHEAD.

No. 309.

Return to Address of the House of Commons of July 29, 1844.

KILMORY.

No. 309.
Return to Address of the House of Commons of 29th July, 1844.

Kilmory House, by Loch Gilphead,
November 26, 1844.

SIR,

IN compliance with the desire of Sir James Graham, as expressed in your letter of the 15th inst., I beg to send you the following information in regard to my quay.

I regret that it cannot be make out in the form of a regular return.

The quay was built in 1813, by my father-in-law the late Peter Campbell, Esq., then owner of Kilmory, at his own expense, for the accommodation of his tenants and others, fishers or small traders. The expense was considerable, but I regret that I am not able to state it exactly. I believe it however to have been about 400*l.* or 500*l.*

After Mr. Campbell's death I purchased the property, and at that time the dues were let for 11*l.* a-year I think—they were once raised to 12*l.*—then I could not get them let for 11*l.*, and had to collect them myself. Before this they were annually let by auction to the best bidder. For the year ending Whitsunday 1840 they were let for 9*l.* 1*s.*

I subjoin a copy of the printed list of charges and regulations which I found in use in 1828, when I came to reside here, and have used ever since.

I regret that I cannot state the amount of expenditure upon the quay, never having kept a separate account of it: whatever repair it requires is done from time to time by my own workpeople, and my own horses and carts, from my own quarries, and with my own wood. Some years ago we were at a great expense in clearing away the mud that had accumulated inside it, and it now almost requires a similar outlay. The authority for collecting the dues is only the ownership of the land, and the only means of enforcing the same is by prohibiting access to it by non-payers. This of course is rather insufficient, particularly as regards the *fines* nominally imposed on those who commit damage not only to the quay but to perches, or to the adjacent beach. These in fact have never been taken. I may add that the quay is very useful to the inhabitants of Loch Gilphead; but as the high road now passes close to it, is rather a nuisance to it—chiefly from nets and sails being hung to dry there. It is only accessible at high water, as the tide ebbs nearly a mile beyond it: it has a mean of perhaps 6 feet water and is quite sheltered. If there were any power to take dues to a sufficient amount, it would be easy to straighten and deepen the river-bed, so as to render it much more useful and even accessible to steam-boats.

As it is, I sometimes think of removing it altogether.

I have &c.,
J. P. ORDE.

The Hon. H. Manners Sutton,
&c. &c. &c.

INVERARY.

No. 310.

Return to Order of the House of Commons of August 9, 1844.

INVERARY.

No. 310.
Return to Order of the House of Commons of 9th Aug. 1844.

Inverary, February 10, 1845.

THE Provost begs leave respectfully to report that the only right or title which the magistrates or community of the royal burgh of Inverary hold, and under which they have invariably acted, with respect to the harbour or port of Inverary, is the charter of erection of said burgh granted by King Charles I., and which charter bears date 28th January, 1648.

The Provost is not aware that there exists any map of the said harbour or port of Inverary, or that there was at any time a report made by engineers or other officers in regard to the same; nor does he know that there have been any written complaints made to the magistrates or community as to the defects of the said harbour or port.

JAMES WRIGHT, *Provost.*

Hon. H. Manners Sutton.

Inveraray.

No. 311.
Income and Expenditure.

No. 311.

Return of the Income and Expenditure for the Years 1842–3–4.

INCOME.										EXPENDITURE.									
Heads of Income.	1842			1843			1844			Heads of Expenditure.	1842			1843			1844		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Anchorage dues . .	47	0	0	43	0	0	56	4	0	Expenditure.* . .	..			..			..		
Petty customs' dues .	12	0	0	14	0	0	13	0	0										
Total . . .	59	0	0	57	0	0	69	4	0										

Dues levied by charter of Charles I, dated 28th January, 1648.

* No account can be furnished of the expenditure on the harbour, as the proceeds of the dues have been appropriated towards the general expenditure of the Burgh.

J. Wright, *Provost.*

Rothesay.

No. 312.
Return to Order of the House of Commons of 9th Aug. 1844.

ROTHESAY.

No. 312.

Return to Order of the House of Commons, August 9, 1844.

Rothesay, April 1, 1845.

The harbour of Rothesay is situated at the head of a large bay, having excellent anchorage-ground, situated in the Frith of Clyde, about 20 miles from Greenock—and which bay is nearly land-locked on every side, so as to form a large basin capable of mooring safely a great number of ships. The harbour was first constructed nearly one hundred years ago by the erection of a pier which cost about 1200*l.*; and about fifty years ago another or second pier was erected, but, when about finished, either from its construction, or the material being bad, it was knocked down by the violence of a gale. These erections were made chiefly through the exertions of the inhabitants, and in the year 1815 they again resolved to further improve the harbour, and obtained a report and a plan for its improvement by Robert Stevenson, Esq., civil engineer; but that plan, though good, was so expensive that the inhabitants could not undertake the works; and nothing was done till 1820, when a second report was obtained from the same engineer. Copies of these reports, marked No. 1 and No. 2, and of said plan, are herewith forwarded.

In 1820 the magistrates and council again took up the subject of the improvement of the harbour, and resolved to partially execute said plan, which they did in the year 1822 at an expense of from 6000*l.* to 7000*l.*—2000*l.* of which they raised by subscription, and borrowed 4000*l.* from the Exchequer Bill Commissioners, and in 1831 they applied to Parliament and obtained an Act by which the present trust is constituted. They have since paid off the sum borrowed from the Exchequer Bill Commissioners, partly from the revenue and partly by borrowing from other sources; and the debt now owing amounts to 1880*l.* 11*s.* 8*d.*

A plan of the harbour as it now stands is also sent herewith. There has been no other report or plan that can be found among the harbour papers.

The title of the Act of Parliament under which the Harbour Trust is constituted is as follows:—1 & 2 Gul. IV. cap. 34: "An Act for improving, repairing, and maintaining the Harbours of the Burgh of Rothesay in the County of Bute, and for building and maintaining a Gaol, Court-house, and Offices for the said Burgh and County." (2nd August, 1831.)

The only complaint made against the harbours is that, from the gradual accumulation of sand at the piers, the depth of water is decreasing.

John Gillies,
Clerk to the Rothesay Harbour Trustees.

No. 313.
Stevenson, on improving the Harbour.

No. 313.

Report by Robert Stevenson, Esq., C.E., *on improving and enlarging the Harbour, and Estimate.*

Edinburgh, November 27, 1815.

In the month of May last, when the reporter was in London, he had the honour to receive a memorandum from the Most Noble the Marquis of Bute, communicated by the Right Honourable Sir John Marjoribanks, Bart., M. P., directing the reporter on his return to Scotland to examine the harbour of Rothesay; to report upon its present state, and of the practicability of its repair; and to give a design for its improvement. Having accordingly visited Rothesay, and there met with the magistrates of the burgh, and with Archibald Moore, Esq., one of the commissioners for the Marquis of Bute, he inspected the harbour; and a survey having since been made of the quays and bay of Rothesay, he is now to submit his report and plan for the consideration of the magistrates and of those honourable persons just alluded to, who take so much interest in the advancement and prosperity of this ancient burgh.

Before entering into particulars regarding the proposed design, it may be proper to notice generally, that Rothesay is one of the royal burghs of Scotland, and gives the title of Duke of Rothesay to His Royal Highness the Prince Regent. The town itself is delightfully situated at the head of Rothesay Bay, which affords a safe and extensive anchorage for ships of all sizes. This bay has an immediate communication with the Firth of Clyde towards the south, and with the coast of Ireland and the British Channel. Again, by the Kyles of Bute on the opposite side it is connected with Lock Fyne, and through the Crinan Canal with all the fishing lochs in the Highlands, while the access to the eastern coast of Great Britain is no less convenient by the Forth and Clyde Canal. Thus Rothesay, the capital of the fertile island of Bute, with a population of 4000 inhabitants, which is rapidly increasing. The capital of its merchants being chiefly invested in the herring fishing, and, indeed, almost the whole industry of the people is employed in this trade, notwithstanding the great difficulties they labour under from the want of means to support their harbour and extend its accommodation with the growing number of their ships. But it must always be recollected, in so far as regards public funds, that the prosperity of the town of Rothesay, even as a seaport, is liable to the disadvantages of an insular situation, and that in common with other small communities it is affected by the change in commercial affairs which draws the residence of merchants and men of

APPENDIX C.

ROTHESAY.

No. 313.
Stevenson, on improving the Harbour.

capital to large towns. Hence the funds of the burgh of Rothesay have been unable to keep pace with the extensive improvements of the contiguous ports of Greenock and Port Glasgow: though of later origin, yet being more immediately connected with the mass of the people, and with the city of Glasgow, that great emporium of Scottish commerce, they have consequently made more rapid progress in the improvement and extension of their public works. In the case of the harbour of Rothesay the evil is felt more severely, its dependence being almost wholly upon the success of the herring fishing; and therefore the safety and accommodation of their shipping become an object of the last importance. Now, from the ruinous state and condition in which the reporter found the piers of this harbour, its shipping must sustain much damage and be exposed to great detention from a want of proper berthage; and this is the more to be regretted as the funds of the burgh are in no condition to renew the quays or to extend the accommodation of the harbour.

The form and construction of the piers of Rothesay, as will appear by the accompanying survey and plan, will be found to be extremely irregular and incommodious. The harbour in its best state consisted of an eastern and western compartment: that upon the eastern side, bounded by the circular pier and the shore, is the oldest part of the harbour, and was afterwards enlarged to the westward by the extension of a pier with a square head pointing towards the east, but this last addition appears to have been so faulty in its construction and in the quality of the materials of which it was built, that it is now in the state of a complete ruin, a great part of it being washed down, the north-eastern head being hardly more than 4 or 5 feet in height, and the area of this compartment is so filled up with silt and mud that it neither affords shelter from the waves, nor a sufficient depth of water for floating the most trifling bark that frequents the port. The small part of the harbour is therefore now the whole accommodation of the port, which is found to be too small for the increased state of the trade; and as the water leaves it entirely at low spring tides, there is only a depth of about 10 feet at high water of spring tides and six feet in neap tides, and is therefore unfit in its present state for floating fishing-vessels of the ordinary size. It may further be noticed that the entrance to this harbour is too near to the eastern side of the bay, and in northerly or easterly winds it is with great difficulty that a vessel can cast off from the pier-heads; and, the water in the bay getting suddenly deep, it becomes both a difficult and a tedious process to *warp a vessel to the offing in order to make sail.* Under these circumstances, the merchants and fishers labour under much inconveniency; and during the time of fitting out the busses or vessels engaged in the herring-fishery, and more especially when they return with full cargoes, a scene of the greatest confusion arises, and they not unfrequently damage each other from the crowded state of the harbour.

In considering the improvement of the harbour of Rothesay one cannot help remarking, that, although the appearance of the town would have been less picturesque on any other spot in the neighbourhood, yet, had it been situate nearer the mouth or apex of the bay, it would have been more easily formed into a convenient *loose* for slips. The position of the harbour, however, is by no means unfavourable, and it can be converted into a safe and well-sheltered harbour at a less expense than if the situation had been more exposed, as it is bounded on no less than three of its sides by the town. The *soundings* or depths of the water in the Bay of Rothesay are rather uncommon from the sudden manner in which the bottom dips from the harbour; indeed, the new north pier delineated upon the accompanying plan is carried as near to the shelving bank as it would perhaps be safe to build. The reporter's attention in forming this design has been particularly directed to the obtaining of a greater depth of water at the entrance and in the interior of the harbour, and to the enlargement of the berthage for shipping; and he is happy to find that about 6 feet in depth of water will be got in low tides at the entrance of the harbour and along part of the new pier forming its northern boundary, while the capacity of the harbour upon the whole will be enlarged to double its present dimensions. This is to be effected by extending and rebuilding in a much more substantial manner the pier called the New Quay, as laid down on the plan, a considerable part of which occupies the site of the present quay, taking only a more northerly direction in order to procure a greater depth of water. The proportions of the new work are stronger, and the accommodations for landing and storing herring-barrels and other goods upon the quays is larger, being 30 feet of roadway instead of 20 or 22 feet in breadth, while it extends about 750 feet in length, instead of 650, as at present.

The better to meet the low state of the funds of the burgh, the operations referred to in this plan may be laid out into three sections. The first section comprehends the deepening of the harbour and the erection of the new north pier; the second includes the eastern or covering pier, with the *graving-dock*, and carpenters' yard, and its face-walls and *forcing* to make up the ground. Also the face-walls at the head or southern side of the harbour, for enlarging the quays next the town, and forming a continuous street round the harbour. The third section of these progressive operations is the further enlargememt of the harbour by forming an additional tide harbour and *scouring basin* on the western side of the present harbour.

The first section of this design (which is all that is now estimated) is so laid down as to embrace the use and continuation of the old pier in its present form, without interrupting the trade while the new works are in progress; and this old quay may remain and answer the purpose of a covering pier until the funds of the burgh shall be in a condition to render it prudent to proceed with the works of the second section.

The works of the second section form a new covering pier, which is projected from the eastern side of the town, and supposes the removal of the circular part of the present eastern pier. This covering pier, by the addition of a returning wall, as shown in the plan, may be made subservient for acquiring additional ground capable of being advantageously laid out for a graving-dock and ship-building yard, the want of which is much felt at Rothesay. Connected with these operations it is intended to build a face-wall round the southern side of the harbour next to the town, by which large additional *quay-room* and a continuous street round the harbour will be acquired, which is calculated to beautify the town and to become the principal port for warehouses and stores much wanted for the use of the merchants.

It will further be observed, in the course of the works of the second section, that it is intended to remove only the circular part of the present western pier, and in some measure still to divide the harbour in its improved state into two compartments, which will be found a great conveniency in berthing the smaller classes of vessels and large fishing-boats.

The further extension of the harbour, forming the third section of what is now projected, will become an easy and obvious improvement at any after period, when the trade of the place shall have extended so as to require still further accommodation than the first and second sections of the design are calculated to afford. At a comparatively small expense another tide harbour of similar dimensions to the one now estimated may be got to the westward, as shown in dotted lines upon the plan, and by

APPENDIX C.

ROTHESAY.

No. 313.
Stevenson, on improving the Harbour.

having a communication through the western wall, described in the first section, a ship in either harbour may sail from the eastern or north western entrance, according to the state of the winds, and thereby great facility will be given to the shipping. A further advantage may be got with this extension of the harbour by the construction of the scouring basin, shown in the plan. This basin may be usefully employed in various ways, for cleaning out both harbours, by penning up the waters of the rivulet which enters the sea at this spot, and letting them off at pleasure; when a second harbour, however, comes to be wanted, it will, perhaps, be more advisable to construct the western compartment of the enlarged plan into a wet-dock for keeping ships always afloat. This wet-dock could be advantageously employed for scouring the eastern harbour, and the basin could be used in the same manner for cleaning out the wet-docks.

To execute the operations now described in a proper and substantial manner, it will be necessary to build all the outward walls of materials of larger dimensions than have hitherto been used at Rothesay; and the reporter is happy to find that at least the *greater part* of the stones wanted, besides the materials of the old piers, which will answer for hearting, backing, and counterfort walls, can be got very conveniently from the *greenstone* or whinstone quarry, marked on the plan, in the vicinity of the town. This vein of rock, about 12 feet in thickness, and of great depth, will also answer extremely well for pitching or causewaying the roadway or space on the top of the piers. About two miles from the harbour, and upon the town's property near the mills of Ascoy, there is good appearance of sandstone rock for hewn work, which lies in regular beds of great thickness, and of a quality much like the well-known sandstone of the island of Arran. Lime of an excellent quality is brought to Bute upon moderate terms from Ireland, and sand is to be had in great abundance at the harbour. The stuff for making up the ground for the new street on the southern side of the harbour and carpenters' yard will be got from the works of excavation in the bottom of the harbour, and also from the rubbish of the greenstone quarry, and from the gravel beach along the shores.

As the greater part of the northern pier, included in the operations of the first section, must be founded considerably under the surface of low-water mark, the expense attending the operation will be more considerable than if the rise of the tide had been greater, and the work had been consequently more out of the water. Here it may be observed, that the difference of the tides in the Firth of Forth, where the perpendicular rise is from 14 to 16 feet in spring tides, while the rise of the corresponding tides in the Firth of Clyde is only from 9 to 10 feet; whereas at the Solway Firth there is a perpendicular rise of water in spring tides of from 20 to 25 feet. To inquire into the causes of this anomaly, depending upon the form of the land and the connection of these estuaries with the great Western Ocean, would be foreign to the present subject; it may, however, be noticed that it becomes a more difficult operation to improve the harbours of the Clyde than of the Forth in making them to have equal depths of water; for on the shores of the Firth of Forth a pier may be founded on *dry land* to acquire a depth of 16 feet of water at the top of spring tides, whilst, the same operation being intended on the Firth of Clyde to have 16 feet of water at high tides, it becomes necessary to build at a depth of 6 feet under the surface of low-water.

But, as some of these works are not immediately wanted for the accommodation of the present trade of Rothesay, the reporter only estimates the expense of the first section of this design, comprehending the erection of the new pier upon the northern and western sides of the harbour, and also the deepening of the bottom by the removal of the sand and other matters accumulated over the whole area of the harbour, from the open and ruinous state in which the piers have been left. These works agreeably to the plan and annexed estimate amount to the sum of 12,946*l.* 16*s.* 6*d.*, and may be executed with the most perfect conveniency to the trade of the port in the course of two years.

In concluding, it shall only further be noticed that, although the sum quoted as the estimated expense of the first section of these works greatly exceeds the limited funds of the burgh of Rothesay, yet, as this harbour, in the strictest sense, is a necessary appendage to the advancement of the British herring-fisheries, both with regard to its position and immediate connection with the Highland lochs, and also from the habits of the people of the island of Bute, whose great pursuit and occupation are to follow the fishing, it is hoped that the restoring and improving of this harbour will meet with the attention of those public bodies whose labours have been so well bestowed for the prosperity and advancement of the Highlands and Islands of Scotland. The reporter will only further observe, that he had once the pleasure to see from 80 to 100 *herring-busses* sail from the bay of Rothesay in one tide for the fishing. What a prospective source of national wealth and security, and how deservedly an object of the fostering care of the legislature, are the British fisheries!

To the Magistrates of Rothesay. ROBERT STEVENSON.

Estimate of the Expense of improving the Harbour of Rothesay by erecting a Pier about 750 feet in length, and deepening the Harbour, agreeably to the accompanying Plan and foregoing Report, by Robert Stevenson, Engineer.

Section First.	£.	*s.*	*d.*
For 2766 cubic yards of squared masonry laid in lime-mortar in the outward walls of the western pier, at 21*s.*, including the materials of the old pier . .	2,904	6	0
For 3259 cubic yards of mound-stones in the hearting between the outward walls, at 2*s.* 6*d.*	407	7	6
For 27 roods of paving with extra large stones for the roadway of the quay, at 84*s.*	113	8	0
For clay puddle, &c., in preparing this wall for the side of a wet-dock . .	150	0	0
For 4127 cubic yards of squared masonry in the outward and inward walls of the northern pier, including the difficulties of the foundation, at 26*s.* . .	5,365	2	0
For 774 cubic yards of rubble-building in the backing and counterforts, at 5*s.* .	193	10	0
For 9492 cubic yards of mound-stones for hearting between the outward walls, at 2*s.* 6*d.*	1,186	10	0
For 34 roods of pitching or paving on the roadway of the pier, at 84*s.* . .	142	16	0
For 168 cubic yards of ashlar masonry in the parapet-wall of this pier, including the Torres course, at 27*s.*	226	16	0
For 12,402 cubic yards of excavation in clearing and deepening the western harbour and clearing foundations, at 1*s.* 6*d.*	930	3	0
For wooden defenders and ring-bolts	150	0	0
	11,769	18	6
For incidents, 10 per cent.	1,176	18	0
	£12,946	16	6

APPENDIX C.

ROTHESAY.

No. 314.

Second Report of ROBERT STEVENSON, Esq., C.E., *on the Harbour.*

No. 314. Stevenson's second Report on the harbour.

Edinburgh, April 17, 1820.

AGREEABLY to a conversation with Archibald Moore, Esq., the reporter had the honour of an interview with the Marquis of Bute on the 29th of March, 1820, when his Lordship was pleased to deliver a sketch plan with relative papers from the magistrates of Rothesay regarding their harbour, with a view to the preparation of a Parliamentary plan and estimate, which the reporter has now the honour of transmitting to the magistrates.

In a report upon this subject, of date 17th September, 1815, to which reference is again made, a plan was then suggested, with an estimate amounting to 12,946*l.* 16*s.* 6*d.*, upon a scale somewhat more enlarged than the accompanying plan, the estimate of which amounts to 10,776*l.* 10*s.* 1*d.*, the area of the proposed harbour being more circumscribed.

The principal alteration made upon the sketch plan which the reporter had the honour of receiving from Lord Bute is in forming the proposed new pier into three kants or reaches, being more convenient and suitable for the berthage of shipping, and also less expensive for the operations of the builder, than the circular form delineated on that plan, while square masonry in the form of kants will be found sufficiently strong and substantial if built of proper materials, a point in which the pier now in ruins is understood to have been very defective.

To obtain a great depth of water, the pier of the sketch plan of the magistrates at the western extremity is proposed to be founded at the depth of no less than from 15 to 17 feet below the surface of low water of spring tides, which would induce an expense far beyond the stipulated means of the burgh, as the rates or charges of building under water increase in a very rapid proportion with the depth. Even with all the economy which the reporter has endeavoured to keep in view, the annexed estimate for a pier founded in about 7 feet water amounts to 2169*l.* 9*s.* 1*d.* more than the sum assigned for the estimate of the sketch plan; but it does not appear to the reporter that the magistrates can with propriety undertake these works without the command of about 10,000*l.* It is not without regret that the reporter states this, but he conceives it to be much better that the expense should be fully stated in the first instance than that the operations should be hampered in their progress from want of funds.

The accompanying plan and *detached estimate* will enable the magistrates to bring their bill into Parliament; and as the reporter will be in London in the course of the session, he can then authenticate these and prove the preamble of the bill in the Committee, should this be found necessary.

ROBERT STEVENSON.

To the Magistrates of Rothesay.

No. 315. Income and Expenditure.

No. 315.

Return of the Income and Expenditure for the Years 1841–2–3.

INCOME.										EXPENDITURE.									
Heads of Income.	1841			1842			1843			Heads of Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Harbour and pier dues upon steam-vessels	433	11	6	372	19	5	420	17	7½	Harbour-master and clerk's salary . .	48	0	0	48	0	0	48	0	0
Ditto upon sailing vessels and boats .	87	10	9	85	11	0	84	0	2½	Improvements on the piers . . .	7	7	1	3	0	8¾	21	14	10
Graving slip . . .	..			45	0	0	..			Deepening harbours	314	10	4½	6	19	4	1	3	2
Incidental receipts .	..			0	7	6	3	0	0	Lighting . . .	39	7	1½	32	16	1¼	26	7	0¼
										Expense of slip .	484	0	11	121	3	0	61	11	10
										Miscellaneous expenses	9	9	1	26	4	1½	47	11	0
										Interest of Debt .	111	2	4	194	10	8	103	6	10
Total . . .	521	2	3	503	17	11	507	17	10	Total . . .	1013	16	11	432	13	11½	309	14	8¾

Dues levied under Act 1 and 2 Will. IV., c. 34.

JOHN GILLIES, *Clerk to Trustees.*

Debt due on the 1st January, 1846, 1471*l.*

DUMBARTON.

No. 316. Income and Expenditure.

DUMBARTON.

No. 316.

Return of Income and Expenditure for the Years 1841–2–3.

INCOME.										EXPENDITURE.									
Heads of Income.	1841			1842			1843			Heads of Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Harbour dues .	287	12	8	230	7	2	212	10	9	Improving quay and deepening river	..			157	5	4½	..		
										Providing diving bell, &c., and working same . .	411	4	0½	..			..		
										Sundries and constables' wages.	..			..			2	12	8
										Law and Parliamentary expenses (opposition to Clyde Navigation Bill, and proposed Harbour Bill)	153	11	10	..			65	0	0
										Total . . £	564	15	10½	157	5	4½	67	12	8

Dues levied under Charter of King James VI., and ratified by Act passed 1641.

PETER DENNY, *Provost.*

Appendix C.

Glasgow.

No. 317.
Evidence taken on the 15th Oct., 1846.

GLASGOW.

No. 317.

Examining Commissioner—Captain Washington, R.N., F.R.S., accompanied by Vice-Admiral Sir Charles Adam, K.C.B., and Captain Bethune, R.N., C.B.

Present:—The Lord Provost of Glasgow; Sir James Campbell; Bailie Anderson; Mr. W. Mills; Mr. C. Gray; Mr. Chapman; Mr. M'Lellan; Mr. D. Bell; Mr. J. Hutchison; Lieut. Forrest, R.N.; Mr. Turner, Clerk to the Clyde Trust; Mr. Readman, Treasurer; Mr. W. Bald, C.E.; Mr. D. Bremner, Resident Engineer; Mr. W. Muir, Collector; Captain Johnstone and Mr. Jas. Russell, Harbour-masters; Mr. M'Connechy; Capt. Boyd; Mr. M'Gregor, pilot; Mr. J. Steele; Mr. G. W. Muir; Mr. F. Galbraith; Mr. Drew, Mr. T. Brownlie, &c.

The Lord Provost said—This meeting has been called in consequence of a letter which I received from the secretary of the trust, stating that Captain Washington, as a member of the Tidal Harbours Commission, intended visiting the port for the purpose of obtaining information connected with the proposed new Conservancy Bill. I have only to state to this meeting of my fellow citizens, that every information, which they have hitherto required, has been afforded by the trustees to the Tidal Commissioners. We have given them the most ample information respecting our accounts, and, in fact, respecting everything that comes under our jurisdiction as conservators of the river. With regard to the Conservancy Bill recently introduced into Parliament, I am sorry to say that I only express my own feelings, and the feelings of the great majority of the merchants, ship-owners, and inhabitants of Glasgow, when I state that this Bill, if passed into a law, will be of serious injury to our port and to our immense city, rising into wealth and influence in consequence of our noble river. I feel satisfied that such information will be elicited to-day as may very likely make the Commissioners pause before they proceed with a measure calculated to be so injurious to the interests of this port and city. Entertaining such views, it will be for the trustees and the public to consider how far they ought to endeavour, through their members of Parliament or otherwise, to prevent this Bill being acquiesced in. Having stated this, I have only further to say, that I consider, as trustees, we are not entitled to take any active part in the proceedings of this Commission. At the same time, we will show the gentlemen composing it every respect, so that they may proceed in the usual way in which such matters are conducted. Captain Washington will therefore now state the design of the Commission, and the object they have in view in meeting you here to-day.

The advertisement calling the meeting having been read,

Mr. David Bell said—But for your Lordship's observations, I would not have offered a single remark at this stage of the proceedings. I am not a Clyde trustee at present; but, in consequence of seeing the advertisement summoning the meeting, I felt myself called upon, as a citizen of Glasgow, to come forward and give the Commissioners and Sir Charles Adam all the information I possessed regarding the trust, the affairs of which I am of opinion have been grossly mismanaged.

Mr. Chapman said, I have been for 25 years connected with the navigation of the river, and I have to say that the affairs of the trust are the reverse of being grossly mismanaged. Nothing could show this better than the fact that vessels which, in 1825-26, had great difficulty in coming up the river, could now come up with ease and safety.

The Lord Provost.—I think it would have been much better had we all remained quiet and and heard Captain Washington; but that was always Mr. Bell's way when he was connected with the trust.

Sir J. Campbell.—I entirely agree with your Lordship's view, that we should not proceed so irregularly as we are now doing; but I cannot concur in your own remarks about the Conservancy Bill. I think it was precluding or rather prejudicing the result that we expect should ensue from the inquiries of the present Commission, and meeting it with rather a coldness that is not due to it. I think it is very well that the Government have appointed the Commission; for if it be found that we have been acting fairly, judiciously, and wisely, I do not fear that any measure will be adopted by the Government injurious to the interests of the river or of the city of Glasgow.

Bailie Anderson.—If Sir James Campbell be allowed to make a speech, other gentlemen will claim the right to reply to him, and this may give rise to a lengthened discussion.

The Commissioner.—This discussion is quite irrelevant. The Commission is not yet formally opened.

Sir Charles Adam then rose and said;—it is perhaps necessary that I should explain why I am here to-day. My name is not absolutely in the Commission; but as I happen to be the senior naval Lord of the Admiralty, a gentleman who has taken a great interest in tidal harbours (Mr. Hume) called on me, and requested me to come here, not with the view of inducing the Clyde trustees to agree to the Bill introduced into Parliament, but with the view of making myself better acquainted than I am at present with the details of this port; and his object was, that we might assist in making the port what this great emporium of commerce deserves that it should be; that we might improve this fine stream, and, in short, that we should do what was in our power to make all matters connected with the harbour and navigation of the river as perfect as circumstances would permit. If this Bill were objectionable in any respect, it must be recollected that it was not intended as a measure for improving the harbour of Glasgow alone, but all the tidal harbours in the kingdom. It has been read a first time, and printed and circulated at the end of the session of Parliament, which is not, as you are aware, quite usual; but the object is, that all who are interested in it may have ample time to examine its contents. Captain Washington and Captain Bethune are here to-day in their peculiar province as members of the Tidal Harbours Commission; and I shall be most happy if in any matter I can give them the support of the Board of Admiralty, with the view, as I said before, of improving the port, and everything connected with it. My attention will be directed more particularly to the way in which the railway companies intend to cross the Clyde. This is a matter always

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 15th Oct., 1846.

referred to the Admiralty, and in regard to which they are anxious to prevent the stream from being improperly interfered with. I have appeared here especially for that purpose; and I shall be glad to find that the railway companies are able to undertake the crossing of the river without causing any obstruction to the navigation. Holding the station which I do at the Admiralty Board, Captain Washington has desired that I should take the part which I am now taking in the business; therefore, without further remark, I would beg that he should now read that portion of the Commission which shows the necessity of the inquiries which we are here to institute.

Captain WASHINGTON having read the Royal Commission,

Sir CHARLES ADAM again rose and said, Captain Washington has taken care, in appearing here, to have an advertisement put in the newspapers, in order that this might be a public meeting, and that everybody might come who felt interested in the inquiry; and that is the best proof which can be given of the intention to conduct this inquiry in the most fair and satisfactory manner, so as to make out a report which will be for the advantage of the port, as well as the public at large. This being the case, it will be desirable that we should hear the statements of ship-masters, sailors, pilots, merchants, and all interested in the welfare of the port. The usual course of proceeding is to commence with the charters and Acts of Parliament, but, as my time is limited, I would suggest that we should begin by calling on some gentleman competent to give us information upon the present state of the harbour and navigation of the Clyde; upon what should be done to improve them? and also upon what relates to the present state of the railways? that is, what authority they have to come to the river at all? what authority they have to cross it? and where they intend to cross it? so that they may be stopped, if at any part that will interfere with the navigation of the river, and sent to cross it at such a part as will not be injurious either to the port or trade of Glasgow.

MR. CHAS. GRAY. CHARLES GRAY, Esq., Chairman of the Committee of New Works, examined:—

The COMMISSIONER.—Can you state what is the present condition of the works connected with the river and harbour?—The question is one that I am not prepared to go into. It is very much beyond anything which, as Chairman of a Committee, should be asked of me; for to give a satisfactory answer to such a question would require an amount of engineering knowledge to which I do not pretend. I therefore beg to decline answering any question of that sort. In reference to anything that has occurred connected with the management of the trust, I am ready to give every information in my power; but as to the prospective improvement of the Clyde, the engineer is the proper person to answer such a question; and the Commission might have had Mr. Walker here to give any information on that subject that was required.

Sir CHARLES ADAM.—Have you any objection to say what is the present state of the works?—I scarcely understand what is meant by the present state of the works. If you mean the present extent of the quayage, I can answer that.

COMMISSIONER.—The intention was, rather to leave it open to you to state generally what is the present state of the navigation. With respect to calling Mr. Walker, that rested with the trustees yourselves; for if you thought that your resident engineer was unable to give the information required, you should have sent for Mr. Walker.—I am ready to give any information as to the state of the works in progress; but I think that calling Mr. Walker from London, in time to attend the Commission, was a thing entirely out of the question; for it was only on Sunday last that I knew I was to be here.

Mr. TURNER, clerk of the Clyde trust.—I beg to state, that I addressed a letter to the Chairman and Deputy-chairman of the trust the very day on which I received the notice from the Commissioners.

COMMISSIONER.—I think I have travelled over a distance greater than that between this and London since the letter was sent to the clerk of the trust, in addition to stopping three days in Glasgow; and, therefore, I conceive it is quite possible that Mr. Walker could have been here, if it had been the wish of the trustees. However, I think we may get what is wanted without Mr. Walker. I understand that you are Chairman of the Committee on New Works: Will you be good enough to state what new works are at present being carried out on the river Clyde?—The new works at present going on are 900 feet on the north side of the quay, and 300 feet on the south side. The trustees, by the Act of 1840, were empowered to purchase ground along the river to the extent of 2700 feet, to form a basin or dock, with an area of 17 acres, and a quayage of about 1000 feet, on the lands called Stobcross; and they had power, under the Act of 1846, to acquire lands on the south side of the river, for quayage, in addition to that at present built.

What other new works are proposed?—The widening and deepening of the river below the harbour.

Is that called for by the state of the trade and navigation of the port?—Yes; the additional quayage is necessary for the accommodation of the trade of the port, and the river requires to be widened to allow large vessels more easy access to the harbour.

Is it proposed to remove the weir at Stockwell Bridge?—Yes; to a point in the river about 140 yards east of Hutcheson's Bridge.

Is this likely to be carried out shortly?—That rests to some extent with another Board, the Bridge Commissioners. I am not a member of that Board, and do not know when they will take down the bridge.

Is there any wish on the part of the Clyde trustees to have that weir removed?—The Clyde trustees have agreed to pay a sum to the Bridge Commissioners towards the expense of removing the weir, and laying the foundations of the piers of the new bridge at Stockwell to a greater depth, so as to admit of the improvement of the upper navigation.

What sum have they agreed to pay?—The sum is left to arbitration.

Has the point of removing the weir altogether ever been taken into consideration by the Clyde trustees?—It has never been formally discussed.

Do you consider that it would be of advantage to the harbour to remove this weir?—In some respects it would be desirable to remove this weir entirely, but it involves many considerations.

The chief object of the weir is to keep up a supply of water for the Water Company?—Yes; we are under obligations to maintain the head level of the river at a certain height for that purpose.

Supposing that water could be procured from another source, would it be desirable to remove the weir?—It might, but the scouring of the river by the tidal flow and by land-floods might cause the banks to fall in, and other injuries to arise. These, however, are matters on which I am not competent to speak.

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 15th Oct., 1846.

MR. CHAS. GRAY.

SIR CHARLES ADAM.—I suppose you have no doubt, Mr. Gray, of the desirableness of removing obstructions, and allowing the tidal waters to flow as high up as possible?—I have heard engineers state different opinions on this subject.

COMMISSIONER.—If you do not feel it convenient, Mr. Gray, to give us a brief history of the improvements on the Clyde, perhaps you will name some gentleman that can do so, as it will facilitate matters very much?—As I said before, I can state the extent of the quays, and the depth of the water at different periods. Vessels drawing 17 feet of water can now come up and down the river.

Can you state what size of vessels could come up at a former period; as, in our inquiry, we are desirous to show the improvements that have taken place, as well as those that may take place, in the navigation of the harbour and river?—Mr. TURNER, clerk of the trust. That is all fully given in the engineers' reports, published in the Parliamentary Papers.

COMMISSIONER.—It would be better if we could obtain that information just now?—I would not like to charge my memory with an off-hand statement of that kind, although tolerably acquainted with the matter.

Do you think that the funds of the port will meet the improvements proposed to be executed on the river and harbour?—I have not the least doubt of that. When I say that the funds will meet these improvements, I do not mean to say that they are adequate to go into them immediately, but the funds will meet them when the works are wanted.

Is that the general opinion of the trustees?—Yes; the revenue is rapidly rising.

During the last year?—It has increased during the last two years, as may be seen from the printed reports; and on the last quarter there is an increase as compared with that of the year preceding.

Can you state whether this arises from an increase in the mineral traffic, or from a general increase of trade?—I do not think that the mineral traffic is increasing at all to the extent of the revenue. I have not the details, but I think the increase is chiefly in the foreign trade.

Will you state what is doing with respect to the General Railway Terminus on the south side of the river, and how far the Clyde trustees have sanctioned the works?—The mode of laying the rails is at present under the consideration of Messrs. Walker and Bremner, the engineers; the Railway Company are, in the mean time, in progress with the works.

Are there any objections, on the part of the Clyde trustees, to the laying of the rails?—Quite the contrary.

It is considered that the railway will be prejudicial to the general traffic of the harbour?—My opinion is, that it will be very beneficial to the traffic.

You have nothing further to state with regard to prospective improvements?—I have stated already what the trust propose to do.

Has the subject of the different proposed railways for crossing the Clyde come under the consideration of the trust?—At present there are really no proposed railways for this purpose before the public; the different schemes having all been disposed of last session of Parliament, and the time not having yet come for giving the notices for next session.

Have the trust come to any decision as to the most eligible place for crossing the Clyde?—They did not reckon that to be their business; but they considered each railway as it was brought before them on its own merits.

Do any of these railways propose to cross between the Glasgow and Stockwell Bridges?—The Caledonian Railway proposed to cross 90 yards on the south side, and 110 yards on the north side, above the Glasgow Bridge.

Is there any proposal to deepen the harbour between the two bridges?—It is one of the contemplated works of the Clyde trust to form a quay of 1000 feet, on the north side, above the Glasgow Bridge, so as to afford accommodation for small craft. It is also their intention to deepen the river, so that the depth at low water will be 5 feet, and at extreme spring tides 15 feet.

Would not the crossing of the Caledonian Railway interfere with that improvement?—It would, to a certain extent, interfere with that improvement; but the advantages to the city from having a good railway station at Dunlop-street, and the compensation to be paid to the trustees, if sanctioned by the Admiralty, are more than sufficient to compensate for any damage done to the navigation. The railway bridge would be much higher than the Glasgow Bridge.

How much higher?—About 11 feet.

SIR CHARLES ADAM.—If the railway bridge were carried across the river at a point above all the bridges, would it interfere with the navigation?—I have heard of such a scheme; but, as it would interfere with the public green, which is of great advantage to the citizens, it would do greater injury to Glasgow than all the advantages of a railway.

COMMISSIONER.—You stated, I believe, that you knew but little about the railways?—The Parliamentary notices are not yet given. I can speak to the plans of last year, but they are all disposed of.

It is probably not a variation of many hundred yards between the place where the Caledonian Railway proposed to cross the river and the point referred to by Sir Charles Adam, above all the bridges?—This is a matter which I cannot enter into.

SIR CHARLES ADAM.—All such questions are rather open questions; but it would be desirable if such information could be elicited on this occasion as would enable the Board of Admiralty to make up their minds on the subject, if the question were proposed to cross either above or below the bridges. I should look upon it as a great advantage if the proposed crossing of the river were to be made above all the bridges. It is not that there is an actual proposition to cross here or there, or that it will be for the public advantage to carry a railway one way or another, but it is as to the best way of crossing the river, without being disadvantageous to the navigation, that the Admiralty are anxious to know the sentiments of those connected with the Clyde?—I have already said that the arrangement made with the Caledonian Railway Company rendered that scheme not objectionable. It was provided, in the Caledonian Company's Bill, that, if ever Glasgow Bridge were opened up, that Company would be required to make a similar drawbridge in theirs, so as to permit vessels to come up.

COMMISSIONER.—Do you think that the Clyde trustees would object to crossing the river below Glasgow Bridge?—Yes, I believe that they would.

You are pretty much of the same opinion as you were last year?—I am.

You were then very decided about it?—I was.

COMMISSIONER, (at the request of Mr. W. G. MUIR).—If the convenience of a railway station in Dunlop-street were so great as to form an equivalent for any injury done to the navigation, would not

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 15th Oct., 1846.

MR. CHAS. GRAY.

the same reason apply with greater force if a convenient site could be got for a railway station above the bridges?—The question assumes an answer which I did not give.

You stated that the convenience of a railway station in Dunlop-street, and the compensation of from 4000*l*. to 8000*l*., to be given by the Caledonian Company, would more than compensate for any damage that would be done to the navigation?—I would say, if a similar compensation were given for a place above the bridge, it would be still more unobjectionable. At the same time, I adhere to my former statement, that if the Caledonian Company give the compensation mentioned, they ought to be allowed to cross at the place proposed, as it was never contemplated to accommodate anything but small vessels between the bridges.

Are you of opinion, if the space were deepened above the Glasgow Bridge, that vessels would make their masts folding?—Yes.

What is the height of the arches?—The spring of the arches is 9 feet 8 inches above high water; and the centre of the arch is 16 feet above high water.

What is the largest size of vessels which pass under the bridge?—About 100 tons.

Has the want of accommodation in the harbour been much felt?—There has been a great want of accommodation experienced in the harbour for some time past. Extensive powers were got in 1840, but the revenue fell off shortly after that, so that it was not considered prudent to push forward the works. I have no doubt whatever, that when the works under contract and proposed to be executed are finished, that there will be ample accommodation.

With respect to Windmillcroft, have the trustees come to any decision regarding it?—It is still in the hands of the trustees.

Who was the consulting engineer at the time it was proposed to make the dock at Windmillcroft; and why has that dock never been constructed?—Mr. Walker was the consulting engineer; and he has given reasons, which are deemed satisfactory, for not proceeding with that work.

Have you any objection to state these reasons?—I cannot state Mr. Walker's reasons in detail; and, therefore, I am averse to enter upon them, because if his reasons were mis-stated, I might involve him as a practical man. I am always averse to entertain or to give an engineering opinion; but Mr. Walker's reasons were such as quite convinced me on that point.

Are we to understand that the trustees were satisfied with the reasons given by Mr. Walker?—Yes.

Are the reasons given in the minute-book of the trust?—Mr. TURNER. Some of the reasons are assigned in the minute-book.

Have you anything else to state, Mr. Gray?—I would like to correct a gross mis-statement made by Mr. Bald, the former resident engineer of the trust, in his evidence before a Committee of the House of Commons, on the 30th of April, 1845. The mis-statement occurs in his answer to question 149, where he states, in reference to the lands of Stobcross, that they were purchased by a company of gentlemen, some of whom were River trustees. This is a gross mis-statement; for I believe, in point of fact, that none of them were ever trustees; and I mention this lest it may have been supposed that the trustees were guilty of a job. I would also wish to contradict a statement made in the House of Commons, by Mr. Hume, that the transaction between the trustees and the Railway Terminus Company was a gross job.

Sir CHARLES ADAM said, he was sure Mr. Hume had but one desire, and that was, to see the harbour and river made as perfect as circumstances would admit of.

COMMISSIONER.—There is one other subject, and that is in reference to the removal of the weir at the Stockwell Bridge; or do you consider that more as an engineering point than anything else?—Yes.

Was it ever referred to a Committee of the trust?—Yes.

Have they agreed to any report upon it?—Yes; and this report is in favour of the removal of the weir; but the report has not been brought formally under the consideration of the trust, although a considerable time has elapsed since it was laid upon the table.

Sir CHARLES ADAM.—Can you state the reasons for this?—It lies with the Chairman of the Committee to bring the matter before the trustees. I do not agree with the Report.

MR. A. M'LELLAN.

ARCHIBALD M'LELLAN, Esq., *one of the Clyde Trustees*, examined:—

COMMISSIONER.—Can you give any information as to what has been done in regard to the removal of the weir at the Stockwell Bridge?—A Committee, of which I was the Chairman, was appointed by the trustees to inquire into this matter. They took very great pains on the subject, and drew up a Report, which had been subsequently printed and circulated among the trustees. That Report contained their unanimous sentiments on the subject. A copy of that printed Report is now on the table of the Commission. [See Appendix, No. 348.] It was the unanimous opinion of the Committee that it would be better to have that weir removed altogether.

Have any steps been taken by the trustees respecting that Report?—The Report has been laid on the table of the Board for consideration; but, as Chairman of that Committee, I have not felt myself called upon to press it, from the peculiar circumstances in which the Clyde trustees are placed with regard to the Bridge trustees. This weir is to be removed under powers of an Act of Parliament obtained, not by the Clyde trustees, but by the Bridge trustees, who are the members of the Town Council, with the addition of nine county gentleman. A submission has been made between the Clyde trustees and Bridge trustees, in regard to the amount of money to be expended, under a plan, at the right, not of the Clyde trustees themselves, but of the Bridge trustees, in sinking the foundations of the new bridge at Stockwell, in consequence of the proposed removal of the weir 140 yards above Hutcheson's Bridge. The Report of the Committee goes, in the first place, to denounce the appropriation of the funds of the Clyde trustees for making a dam within the tidal flow; and, in the next place, to deny the right of any joint stock company or private proprietor to stop the tidal flow, or prevent the improvement of the river within high-water mark. The present circumstances of the case are, that the matter has been, by submission, referred to Mr. Walker, the consulting engineer of the trust, and Mr. Smith, of Deanston, who have full powers to say what sum shall be taken for the purpose from the funds of the Clyde trust and put to the credit of the Bridge trust, and this submission I hold to be illegal.

Was there not a previous sum taken from the funds of the Clyde Trust and given to the Bridge Trust?—Yes; a contribution of 6000*l*. was given when the Glasgow Bridge was rebuilt. I consider

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 15th Oct., 1846.

Mr. A. M'LELLAN.

this to have been ample compensation for any surface or other damage which would be inflicted on the bridges from the traffic connected with the harbour.

Are you of opinion that no further sum should be given to the Bridge trust?—I am.

Do you consider that the removal of the weir would be an advantage?—Yes.

Mr. TURNER.—I beg to say, with great deference, that Mr. M'Lellan is much mistaken in the statement which he has made. He says that the contribution is to be made under a plan, and expended by the Bridge trustees. The true state of the case is this. The Bridge trustees said, "We shall build a new bridge." The Clyde trustees said, "You must lay the foundations of that bridge sufficiently deep." The Bridge trustees said, "That is not a bridge purpose." Accordingly the Clyde trustees prepared a plan of additional foundations, and gave in an estimate of the amount, at 8000*l.*; and they said, in order to carry the navigation as far up as possible, we request that you will seek power to sink the foundation to this extra depth. Then with regard to the weir, the Bridge trustees said, "You [the Clyde trustees] desire its removal above Hutcheson's Bridge, but before this can be done, the Water Company, the manofacturers, and the trustees for the Bridge of Rutherglen, who have all separate interests in its maintenance, must be compensated; therefore, in this way, the removal of the weir more properly belongs to you than to the Bridge trust."

Mr. M'LELLAN.—I hope I may be permitted to correct Mr. Turner, and to say, that he has not given a fair statement of the case in the gratuitous speech he has made. What Mr. Turner has just stated must be taken *cum nota*, as he stands in the anomalous position of being clerk to the Bridge trustees and clerk to the Clyde trustees.

Mr. TURNER.—So much the better able to give a correct statement of the case.

Mr. M'LELLAN.—In regard to this weir, I take leave to say, as a Clyde trustee of 25 years' experience, that I consider it to be one of the greatest barriers to the improvement of our noble river. I consider further, that the removal of it a few hundred yards would be of no value as an upper scour. I believe that there is no obstruction to the removal of the weir, as the Water Company are now to be placed in a new situation by the introduction of water by means of gravitation. If they can prove a shilling of damage, which I believe they cannot, the sinking of this level, and every other obstacle, if treated in a fair and honest manner, can easily be overcome.

COMMISSIONER.—Is there not a new Water Act to bring water from a distance?—I believe it is in operation at this minute.

The LORD PROVOST.—The time is limited to five or seven years. I am a proprietor and director of that company, and I can state that it is not possible to bring in water, on an extensive scale, in less than five years. Therefore, whatever resolution the Clyde trustees may come to in reference to the position of the Water Company, it is evident that, by the removal of the weir at present, the city of Glasgow would be deprived of that essential necessary of life, water.

COMMISSIONER.—We do not understand Mr. M'Lellan to mean that the weir is to be taken away until a supply of water be secured?

Mr. M'LELLAN.—I have found it my duty to do what I could to prevent the Bridge trustees from undertaking the erection of a new weir. The Act requires them to erect the new one before the old one shall be removed; and this new weir is to be constructed of stone, and finished in every respect in a sufficient manner. Now I have to say to the Commission, that it will be the most arrant waste of public money that could be committed, and the most flagrant injury to the funds of the Clyde trustees, if they shall allow one stone to be put on another for the construction of a new weir above Hutcheson's Bridge. The Bridge trustees have it in their power, if they shall build a bridge at Stockwell, to preserve the level of the water for the different companies. I hope that the opposition which I have taken in this matter will prevent one farthing of the Clyde trustees' money from being applied to such a destructive and suicidal purpose.

Bailie ANDERSON.—There is no collision between the Bridge trustees and the River trustees. The Bridge trustees are not bound to erect the new weir till the other one is removed, and they were not bound to remove the present weir. They may, therefore, build this new bridge, keeping the weir as it is; and that is what they intend to do. They have already issued specifications for the building of the bridge, with the weir to remain as it is. It was not the duty of the Bridge trustees to remove the weir, but if the Clyde trustees wished it, they were desirous of facilitating its removal by every means in their power. Last year there was a very general feeling in favour of the removal of the weir as far up the river as possible. They endeavoured to accomplish that object, and had powers in their Bill to remove the weir a mile or two up; but they found that there were so many difficulties in the way, from the Water Company and the manufacturers, if they took powers to remove it so far up, that they considered it desirable only to remove it to where it was proposed, above Hutcheson's Bridge. I can corroborate what was stated by Mr. Turner as to the difficulties in the way of removing the weir farther up. There cannot be a doubt but that it involves serious consequences to the manufacturers on the banks of the river, and therefore is it that the Clyde trustees have not gone into the matter, or taken up this Report of Mr. M'Lellan's. It is, in a great measure, his own Report; and although only laid on the table, it states that the Committee have authorized copies of it to be sent to the Admiralty.

Mr. M'LELLAN.—It is the unanimous report of the committee, and I pledge myself to bring it before the first meeting that shall take place.

Bailie ANDERSON.—I beg to repeat that the Bridge trustees will do everything that they can for the removal of the weir. Of course, if the Clyde trustees wish the weir removed above Hutcheson's Bridge, they must be responsible for the expense connected with this operation.

COMMISSIONER.—Are you bound, Mr. Anderson, to lay the foundations of the bridge as deep as the improvement of the navigation of the river may require?—We have power to make them as deep as we choose. Of late it has been considered advisable to have them three feet deeper than those of Glasgow Bridge. The Bridge trustees will be glad to sink them as considered necessary.

Sir CHARLES ADAM.—At whose expense?—At the expense of the River trustees.

COMMISSIONER.—Is it very desirable to get rid of the weir?—I think that is the general opinion among the trustees; although an opinion which we got from Mr. Walker leads us to believe that it is not of that importance which Mr. M'Lellan would have us to believe.

Have you seen a report which stated that it would be the greatest improvement which could be made upon the Clyde?—Yes; by Mr. Logan.

Are you aware how high the tide would flow up if the weir were removed?—About six or seven

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 15th Oct., 1846.

Mr. A. M'LELLAN.

miles. It has been stated as an objection that, in the event of the weir being removed, the lower part of Glasgow Green would be overflown by the greater rise of the water, which would be looked upon as an evil.

Would not an embankment prevent this?—It might.

Mr. M'LELLAN.—I cannot understand where Bailie Anderson has got that information. The removal of the weir would rather have the effect of preventing the flooding of Glasgow Green.

[Mr. MACKAIN, the engineer of the Glasgow Water Company, here stated, in answer to questions from the Commissioner, that several private parties, as well as the Water Company, were interested in the maintenance of the weir; that the Water Company had got an Act of Parliament to bring water from Loch Lubnaig by gravitation; that the supply from this source would be 22,000,000 gallons per day; that the present supply was between 9,000,000 and 10,000,000 gallons; that it would take five or six years to execute the works; that in 1807 one small engine was sufficient to supply the whole city, working a few hours a-day, but that now there were eleven engines constantly working; and that the present Water Works might still be maintained after the new works were in operation, for the purpose of supplying the public works.]

COMMISSIONER.—Are you aware, Mr. M'Lellan, that there is a great expense incurred in dredging the harbour?—It constitutes a principal element in the annual expenditure. I think the effect of the tidal scour, by taking the weir away altogether, or removing it further up, will save one-half of this expense.

Can you state if any engineering opinion has been given on that subject?—Our late engineer, Mr. Bald, took great interest in this matter, and has prepared several reports.

How long was Mr. Bald engineer to the trust?—About six years.

Is there any other impediment to the flow of the tide?—Yes; the bottom of the channel at Dalmarnock Ford.

Is there any obstruction at the Newshot Isle?—I think the Newshot Isle one of the most serious obstructions to the flow of the river.

Have pains been taken to preserve or to increase the depth of the river there?—Yes; considerable pains have been taken, particularly on the northern side of the Newshot Isle. The southern channel is in course of silting up. There is an artificial mound across it, which has, during the last 12 or 18 months, been heightened very considerably.

Mr. TURNER.—The trustees have had their attention directed to it. I believe it was made without the cognizance of the trust; although one or two may have perhaps been aware of it.

Can you tell us who placed the southern dyke there?—The trustees have acted on the system, for more than half a century, of confining the channel of the river as much as possible. They had no steam power wherewith to dredge the river. They found the natural channel of the tide wide; and, under Golborne and Rennie, their operations went to confine the tide to a narrow channel. I suppose the dyke at the Newshot Isle was put down by these engineers for that purpose. They did not allow it to be put up unless on the principle of a half-tidal dyke; but it has been raised since.

Has any attempt been made to put it down?—An attempt was made by Mr. Bald to take it down.

And was he not successful?—He was frustrated in more attempts than in this.

Sir CHARLES ADAM.—Are you aware what was the opinion of Rennie and the other engineers in regard to that tidal dyke?—I believe that, in the limited state of the revenue, they considered that the confining of the river was the principal way to proceed; but now circumstances are so completely altered, as to require the Clyde trustees to take a very opposite course. They have now large funds at their disposal, averaging 45,000*l.* per annum instead of 9,000*l.* twenty-six years ago. With this large sum at their disposal, they have four powerful steam-dredges constantly operating on the bottom of the river. They find, from the great increase that has taken place in the size and tonnage of vessels—from 100 tons to 500 and 600—that the river is too narrow; therefore the dykes, which served the purpose of these engineers, are now to be removed. The system which we are now carrying on is, that the river should be widened instead of being narrowed in its course. We are about to buy the whole of the ground to the west of the harbour and the estuary, and I hope we shall get it for less than what it is estimated at, 120,000*l.* If the improvements projected are carried out, the river, instead of being only 170 feet wide in some places, will be 400 feet on an average. Great inconvenience arises at present from the narrow state of the river at some points; and especially, the difficulty experienced in turning corners often leads to the grounding of vessels.

Is there a great want of accommodation in the harbour?—Yes.

How could this be remedied?—By carrying out the plan of 1840 on the north and south sides of the river, both above and below the bridges.

Where do you consider the estuary to begin?—On the property of Lord Blantyre, near Old Kilpatrick.

COMMISSIONER.—Has the harbour accommodation been extended upwards above the bridge?—It has; but not so much as I could have wished. It has an extent of about 500 feet of wooden quayage. As to dredging above the bridges, the question between the Bridge trustees and the Harbour trustees as to the amount of damage we shall pay for the bridge, has prevented us from doing this. The wooden bridge was also another obstruction to the upper part of the harbour, but that is now in course of removal.

Will the foundations of the present Glasgow Bridge admit of the deepening of the river?—Yes, I think they will, for all purposes that the Clyde trustees contemplate applying this sheet of water.

What is the state of the quays?—They are in an indifferent state. Some have been in existence for 25 years, and others have been in existence for seven or eight. The latter of these are in pretty good condition.

Whom were they built by?—They were built by the Clyde trustees under contract.

Are the works still carried on by contract?—Yes, as much as possible, even in the very smallest matters; it being prescribed by Act of Parliament, that no work above 50*l.* shall be undertaken, unless by contract or competition.

You are aware that land was acquired at Windmillcroft for making docks; can you tell why these docks have not been made?—I have heard it said that the soil is not well suited for impounding water.

Is that ground still retained in the hands of the Clyde trustees, and at what expense?—Yes, at an expense of about 1600*l.* per annum. They get some revenue, however, from it.

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 15th Oct., 1846

Mr. A. M'LELLAN.

Sir CHARLES ADAM.—Was the harbour not widened there?—Yes; and, of course that advantage has a fair right to be deducted from this expense. It is one of the most crowded parts of the harbour.

Has the land increased in value since it was acquired by the trust?—It has been more than doubled in value, so that if you take into account the amount of profitable occupation, it will materially reduce the outlay connected with it.

You must likewise take into account the increased value of the ground?—Of course. I was of opinion that we should dispose of the lands of Windmillcroft, but Mr. Walker and some of the trustees objected. I do not, however, see any great harm in keeping it.

The COMMISSIONER.—Do you think it will be a benefit to carry out the General Terminus Railway?—Yes.

Is it intended to widen the harbour to 400 feet there?—To 480 feet.

You have no fear that the increased traffic will block up as much as the increased room?—No; because the trustees have the power to distribute the traffic.

Do you expect that the traffic will be chiefly a mineral one?—I do not think that it will be a mineral traffic alone, but a general traffic. The shipping of coal is diminishing instead of increasing, as the iron-works require nearly all the out-put of the coal-fields.

Do you think the acquisition of the grounds of Stobcross a judicious purchase?—I think so; but I do not think that the trust have money to carry the docks out.

Would you prefer quays and deepening above the bridge to docks being made at Stobcross?—I have always urged that fine sheet of water to be taken advantage of.

Would that relieve the harbour?—Yes.

Do you think that vessels would fit themselves for passing at the bridge?—I have no doubt that they would fit them by folding masts, if we allowed them to use that part of the harbour.

Where are the greater number of the store-houses?—Below that point.

What is the nature of the barge traffic?—It is a desultory traffic. The Clyde Shipping Companies bring up the varied contents of the deep-sea ships, which are put down on these upper wharfs. There is also the traffic from the West Highlands. I have no doubt at all, if we had sufficient accommodation at the upper harbour, that it would all be used; and if powers were got at some future time to build a quay on the southern bank, I am confident that we would be able to fill that also with vessels.

You mention that you have been in the Clyde trust for 20 years?—Yes.

Has the trust been at any great expense in obtaining Acts of Parliament?—Yes.

Owing to opposition?—Yes. One railway company cost us 10,000*l.*, the West of Scotland Junction Company. We likewise incurred serious sums from the opposition of proprietors. An acquisition of ground, for instance, from Messrs. Tod and Higginbotham, cost us a heavy amount. We have also had a good deal of opposition in maintaining our rates.

Do you know what the Act of 1840 cost; from the Parliamentary return we see that it cost 12,320*l.*?—Yes.

Do you not consider that a grievous burden on the funds of the trust?—Yes.

Do you not think, if a department of Government were instituted to examine into such Bills, and if approved of, to carry them through Parliament as public Bills, it would be an improvement?—Yes, I think it would tend in a great measure to smooth the way in getting the powers necessary for executing admitted improvements.

Do you think that a Board of Government Control, to which points of difficulty could be referred, would be beneficial?—Yes.

Do you entertain the same objections as the Lord Provost to the whole of the Conservancy Bill?—I am in favour of the principle of the Harbours Conservancy Bill; to some of the details I object.

Are you aware that it would be one of the objects of that Conservancy Board to prevent all this expenditure in the carrying of Bills?—Yes, I think so. During the last two sessions of Parliament we had occasion to make application to two departments of Government; to the Admiralty in respect of the railway aggressions, and to the Commissioners of Woods and Forests. A special board to which we might address ourselves would be a great improvement, as these two great Government boards are overwhelmed with business.

Do you consider the expense incurred connected with the railways a legitimate expenditure of the trust funds?—By no means; but the trustees are not to blame, for they had no choice. If the railway companies are not prevented by Government, the same thing will perhaps occur next session.

What is the best point for the railway companies to cross the river?—I think that there are points at which the river might be crossed with little detriment to the harbour; but not below Glasgow Bridge; I would not allow of any tampering with the deep-sea shipping. Nothing could compensate the inhabitants of Glasgow for the appropriation of a square yard of that harbour for a railway purpose. I would like to see the communication above the whole of the bridges; but when you take into account the convenience of the citizens of Glasgow, which the river trustees would not like to run in the teeth of, I think some sacrifice might be made by which to accommodate the citizens in respect to a terminus on the north side of the river, which is required for the business of the south of England and the west.

Sir CHARLES ADAM.—Would it take the railways much round to go above the bridges entirely?—No, it would not. I think there are two objects in which the citizens of Glasgow and the railway companies are at one: that there should be a terminus in the city, and on the north bank of the river, for the western and southern traffic. There would be great risk in compelling the citizens, who occupy the north bank of the river and where four-fifths of the population exist, to transport their goods to the south side of the river.

Mr. CHARLES GRAY, through the Commissioners.—You are aware, Mr. M'Lellan, that the sum of 5400*l.* was incurred last session in opposing the Glasgow Junction Railway Bill?—Yes.

Mr. GRAY.—You are aware that the principal part of that expense was incurred in Committee?—Yes.

If the Admiralty had adhered to their previous determination not to allow any railway to cross below the bridges, instead of leaving this Bill to the decision of a Committee of the House of Commons, and then stopping it when it was eleven days before that Committee, it would have saved all this expense of 5000*l.*?—Considering the pressure which that Board were under by the

APPENDIX C.

GLASGOW.

No. 317.

Evidence taken on the 15th Oct., 18-6.

MR. A. M'LELLAN.

speculation of that period, I do not wonder at their being hammered out of the decision to which they originally came. At the same time, I can see this from what has occurred, that if, instead of a great national Board, with a constant pressure upon it, we were to have a branch of the Admiralty, with power to take up such matters, it would enable us to get our business both more cheaply and better done.

COMMISSIONER.—Could not a crossing for the railway companies be effected above Hutcheson's Bridge?—Crossing above Hutcheson's Bridge by arches I do not think would be prejudicial. From this bridge over the Clyde into the city, the railway would run along the left bank of the Molendinar Burn, and proceed in a straight northerly direction to the terminus which had been acquired by certain railways on the site of the College; then to obtain a junction with the Edinburgh and Glasgow Railway, they had only to cross one or two streets, with a sufficiently favourable incline, and proceed in the ravine to the east of the Cathedral, and by tunnel beneath the basin of the Monkland Canal, and a few thousand yards would lead them to the terminus of the Edinburgh and Glasgow Railways at Cowlairs. I think such a junction line could be accomplished with great ease.

Are we to understand that this crossing will be over the Green of Glasgow?—Across the west end of the Green, and about 200 or 300 yards in front of the public offices. I do not see that the citizens would object to a magnificent bridge being erected. I think such an erection, instead of being a drawback, would be an ornament to the city.

Do you think that the general feeling of the community is against crossing below Stockwell Bridge?—I have not heard any general feeling against it, taking into account the necessity for a terminus on the north side of the river; but there is a general expression against crossing below the Glasgow Bridge. I never heard any person speak in favour of it, except interested parties.

Mr. G W. MUIR, through the COMMISSIONERS.—Will the crossing through the Green, to which you have referred, supply, in your opinion, the wants of the Caledonian Railway Company, who wish to cross below Stockwell Bridge; or will both bridges be necessary?—That is a question which I cannot undertake to answer, as I am not a proprietor in that railway, and not in their secrets.

Sir JAMES CAMPBELL, through the COMMISSIONERS.—In any crossing of the Clyde, by a railway bridge, would it not be desirable that it should be at a point that it would at the same time admit of a connexion with the railways on the north side and those on the south side?—I do not think so. I think the junction crossing should be above all the Glasgow Bridges, while a crossing expressly for the English and western business ought to be afforded below the Stockwell Bridge.

We think we understood you to say that there was no expression of feeling against crossing at the Green?—I am not aware of any expression of feeling.

[Mr. TURNER here stated that, in regard to the Newshot Isle, some parties had advised the trustees as to a change of the channel; but if the Commissioners would refer to the Reports of Mr. Rennie, Mr. Telford, and Mr. Walker, they would observe that these gentlemen were in favour of the north channel. The Newshot Isle belonged to Mr. Campbell, of Blythswood; and all that the trustees could do was to prevent any of the inlets from being filled up. The little dyke had never been deliberately under the consideration of the trustees, but when it should, they could apply to have the bank fully removed, if it was supposed to prevent the flow of the tide in the southern channel. Then, in regard to Stobcross, it was not intended to proceed immediately with the works; but it was indispensable, in obtaining powers, that they should bring forward plans and estimates. The trustees might take 50 or 100 years to complete the works; and, therefore, all that they had as yet done was to acquire the lands.]

MR. D. BREMNER.

MR. DAVID BREMNER, *Resident Engineer*, examined.

COMMISSIONERS.—You are the resident engineer of the Clyde trust?—Yes; for the last seven months.

Have you been connected with any other harbours?—Yes; I have been connected with the harbours of Wick, Sarclet, Keiss, Sandside, Granton, Banff, Lossiemouth, Hartlepool, &c.; and I have been acquainted with harbour and other engineering works 14 years.

In what state did you find the harbour works when you came here?—On the south side of the harbour, 575 lineal feet, and on the north side 375 lineal feet had much given way, and were going rapidly into the river.

How long is it since these quays have been built?—They were built about 11 years ago, I believe.

Did you take means to secure them?—Yes; great energy was used to secure those that were not altogether gone, and two portions that were so had to be taken down; the whole was done so as to interfere very little with the traffic of the quays, except a portion, 175 feet in length, on the south side, which was taken down before I came to the Clyde; this portion has not been used for 18 months, and cost more than the whole length of 775 feet beside; the means used have been completely successful in securing the walls.

From your experience, what would you think of quays that should be found, 10 or 11 years after they were built, falling into the river?—The present depth of the Clyde had either not been anticipated, or if so, not sufficiently kept in view in their design and construction.

By what engineer were these walls built?—Mr. Atherton, I am informed.

Will you proceed down the river, and say in what further state you found the river?—I have a statement showing the deepening that has taken place in the river. The present state of the river is very much in accordance with what Mr. Rennie proposed in 1807.

What is the width of the narrowest part of the river?—The narrowest part is 170 feet at the river Kelvin; but it is only a small portion of the river that is of this width. The general width, from Renfrew to Glasgow, is from 170 to 250 feet—widening in the harbour of Glasgow to 420 feet, at that part where it was proposed to be 135 feet, by Mr. Rennie.

By whom was that width proposed?—The plan for widening was proposed by Mr. Logan in 1835. Mr. Walker's plan was a shade higher, for which an Act was obtained in 1840. In the harbour 560 feet in length have been carried out; and at Whiteinch there is an extent of about half-a-mile of the Parliamentary breadth. Ground has been acquired on each side of the river for the operation of widening and extending the harbour.

Are there not at present several projections into the river which prejudicially affect the tidal

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 15th Oct., 1846.

MR. BREMNER.

scour?—There are a few jetties prejudicial to the tidal flow; one at Dunglass, and another at Erskine Ferry.

Have you made any observations to determine the flow, of the tide at these points?—No; the greatest obstacle is at Newshot Isle. I examined that part at the wish of the trustees; and I am of opinion that there is a considerable check there, owing to the south reservoir being blocked up by cross dykes, which form overfalls at a certain level of the flowing tide.

From your experience as an engineer, is it desirable to obtain the greatest amount of tidal water for a scour?—Yes.

Do you know any better mode of scouring?—Certainly not.

Are you of opinion, if the tidal scour were promoted, that the expense of dredging would be greatly saved?—I am decidedly of that opinion.

What is the annual expense of dredging?—About 8000*l.* a-year.

Are you of opinion that the encouragement of the scour is essential for the benefit of the Clyde?—Yes, and all the more as the rise of tide is limited and the bed of the river is nearly a dead level.

Is it essential to carry it as far above the bridge as possible?—The only drawback is, the tortuous course of the river above Glasgow; and the throwing back the time of high water in the harbour.

What do you mean by that?—I mean that it would not be high water so soon at Glasgow Quays, if the tide were permitted to flow six or seven miles above them.

Which would be the best for the navigation?—It would decidedly lessen the expense of dredging, and tend to greater depth in the river generally, to bring the tide up to the highest point to which it would flow, by removing all obstructions thereto.

How many minutes of difference would it make in the high water?—To carry the tide up seven miles further would throw high water half-an-hour behind, I apprehend.

What is the difference in high water between Greenock and Glasgow?—1 hour and 45 minutes, in a distance of 18 miles.

Do you know where the chief throttling of the tide takes place in the Clyde?—I am much inclined to believe that the great detention in the Clyde is between Rashalee Quay, and the pier at Clyde Bank, which includes Newshot Isle. Mr. Russell made an extensive series of observations from one end of the river to the other.

Are you of opinion that it is desirable to open up the south channel by the Newshot Isle?—That is the decision to which I have come, as will appear by my report upon it to the trustees, to use this much-abused and extensive water space as a tidal reservoir and timber pond.

What is the extent of the Newshot Isle?—About 60 acres; the water space was, not long ago, 102 acres, but it has greatly lessened of late. Either the channel must be opened or closed altogether, so as to allow the tidal flow upwards. We are going on gradually widening and improving the main channel of the river. This season there have been dredged and deposited about 89,000 cubic yards between Rashalee and Dumbarton.

Do you think there is any tendency to fill up again when the bottom is once lifted?—No; I do not think so.

How is the sand deposited?—The sand is brought down by the freshes at Rashalee; but at Dumbarton there is a considerable deal carried up by the tidal flow from the estuary.

Are any of the transverse dykes still left projecting?—There is one cross dyke at Erskine Ferry, and a parallel or longitudinal dyke at Dunglass Castle, that project rather from the general direction of the banks.

Have you made any recommendations for the improvement of the river?—Yes; in reference to the south side of Newshot.

Can you tell the expense of repairing' the walls?—I have not the statement at present at hand.

From whom do you receive your orders in reference to the works?—From the Committees of New and existing Works. I attend every meeting of these Committees.

Whom have you on the river under your orders? Mr. Maconochie is the foreman, to whom I give instructions.

If any particular improvement should occur to you on the river, do you consider it to be your duty to suggest it to the trustees?—If I saw anything which required immediate looking after, I would report it, and ask instructions to carry the necessary improvement into effect without delay.

Are your instructions so defined that you understand your duties?—The duties to which I have been appointed are distinctly stated, but they are now, in my relation to the treasurer, being more distinctly defined by the trustees.

No single member of Committee has authority to interfere with your work?—No.

I see it in evidence that your predecessor was directed either to pull down or to build up a dyke by an individual member of Committee; you would not consider yourself bound to act under such orders?—No; I would consider myself bound to bring it before the Committee, in whose province it was.

What is your opinion of the weir at Stockwell Bridge?—My opinion is, that the weir has a very prejudicial effect on the property in Glasgow, in forcing the water upward in freshes, so as to flood houses; that it makes the harbour the stagnant cesspool of the city, the filth from which, by deposition, is the cause of unnecessary dredging in the harbour, to the great inconvenience thereof, as well as of noxious vapours for miles from the Broomielaw in summer time; and that so long as this nuisance exists, the tidal scouring power, both inward and outward, will be rendered unavailable for the upper reach of the Clyde. I have been informed, that this great obstruction has only existed for about 50 years.

Do you think it should be removed?—It would be higly desirable and beneficial for the great interests of navigation, for the rights of property, and for the health of an extensive portion of the city of Glasgow, to remove it entirely.

Have the proposed lines of railway to cross the Clyde come before you at all?—No; there have been no new lines since I was appointed engineer to the trustees.

The LORD PROVOST.—Regarding the north channel, does not the existing Parliamentary line take off a considerable part of the Newshot Isle?—Yes.

Would not that materially improve the present channel?—Yes, it would. The Parliamentary plan contemplates cutting 100 feet off the Newshot Isle.

3 E

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 15th Oct., 1846.

Mr. BREMNER.

Are you aware of any difficulty to the diverting of the channel south of Newshot?—Yes; I am told there is rock.

COMMISSIONER.—Has that channel never been bored? Did not Mr. Logan give a plan of deepening it?—Mr Logan does not give the section of that portion.

Mr. BELL.—Are you aware whether, by the removal of the Old London Bridge, and the higher ascent of the tide, the time of high water was delayed in the Thames?—I am not aware of the fact; but what I spoke of was, that in the event of the upper navigation being carried to a great extent, the *time* of high water would be put back.

COMMISSIONER.—What do you mean by a great extent?—I mean the carrying of the tide up from 7 to 15 miles.

Would the levels admit of that?—I am not aware that they would at present.

Mr. BELL.—How would you proceed in improving the southern side of the Newshot Isle?—I would take up all the walls in the middle, and put up a higher wall at the east end, and then the tidal flow would be regulated inside the same as outside the water space, which is very far from being the case at present.

What would be the cost of opening the upper end also of this channel?—It would be attended with some expense, say from 1200*l.* to 1500*l.* to open it.

What is the width of the river at Dunglass?—The width of the river at Dunglass is 410 feet, and by the Parliamentary plan it should be 660 feet.

COMMISSIONER.—Is there any prospect of arriving at this desirable result?—Yes; as soon as the trustees can arrange it. I believe they are prepared to widen; but it is a matter which requires great caution.

Have you read former reports on this southern channel, at Newshot; and, if so, are you aware that it is stated in several of them that it was used as a navigable channel?—I cannot speak to that point.

Mr. M'LELLAN.—It is a historical fact. The right of way over it has been lost through carelessness. Perhaps Mr. Bremner would tell us what distance would be saved to the navigation by using the southern instead of the northern channel?—120 lineal yards, supposing the channel on the south side be made as direct as it is possible to be done.

If there were no obstructions in this channel, and no impediment offered by Mr. Campbell of Blythswood, would you not have this channel opened up as the legitimate channel?—That would become a question, if the river were once improved down to Renfrew. It is a more direct channel, and desirable on that account.

Would it not be less expensive to maintain that channel than the present circuitous one?—It would be only a shade less; as the whole length is only about a mile and a half, and the present channel there, I am informed, requires no dredging for maintenance.

Is it not an advantage to have a direct channel, to prevent alluvial deposition?—Yes.

COMMISSIONER.—You say you do not know anything about the alteration in the rise of tide caused by removing Old London Bridge. As there has been a gain of two feet at London Bridge in consequence of the ascent of the tide, perhaps you might give us your opinion whether a similar result might not be expected here?—That would depend on the bed of the river. If the bottom were made shelving, it would rise rather higher at high water than it is at present.

[Mr. TURNER here explained, that, by the Act of 1825, the harbour was only deepened to the extent of 13 feet, whereas, by the Act of 1840, it was authorized to be deepened to the extent of 17 feet; and, therefore, the depth of wall applicable to the Act of 1840 would not apply to that of 1825. It was that which brought down the quays, and not any fault of the engineer by whom they were erected.]

Has the river been deepened to that extent?—Yes; there are 17 feet of water in the harbour with spring-tides, and 15 feet 6 inches in neap-tides.

You are aware that in questions of improvements in rivers and harbours tidal observations are of great benefit?—Yes.

Are any tidal observations registered?—Not since those made at Newshot Isle and at the Broomielaw simultaneously have been completed.

Are there any means for making such observations?—Yes. The coping of the south quay serves as a datum; and it is about 10 feet 3 inches from the surface of the water to the datum.

Are the quays ever overflowed in heavy freshes?—Yes; I believe they are. They have been only once overflooded since I came to Glasgow.

What does that arise from?—From the confined section of the river, and the want of declivity in the bed of the navigable channel.

Has any damage been done to property by this overflowing?—There was very trifling damage done on the occasion to which I have alluded.

Is this not an additional reason for widening the river?—Yes.

[Mr. TURNER.—Perhaps I may here be allowed to state, that the trustees have, in the most praiseworthy manner, come to the decision of acquiring the whole ground, for the purpose of widening and improving the river.]

Are there no impediments in the way?—None that I am aware of. It is the intention of the trustees to carry out the improvements as speedily as possible: they may be done in a very few years. I would undertake to do all the work in five years.

With your present force?—No; but with increased funds and extensive contracts it might be done in five years. With the progressive increase which the revenue has been showing, it might be easily done in 10 years.

Would it not be desirable to make a forced outlay at present?—I am quite of that opinion.

Mr. GRAY.—I would like to ask Mr. Bremner if he has turned his attention to the best use that might be made of the space between the bridges?—I think it might be very usefully devoted to the accommodation of small craft—from 80 to 90 tons burden, and under, and for which the great depth now in the lower harbour renders it unfit, particularly at low water, when, from their level below the quays, the business of loading and unloading has been suspended for hours together.

Do you think that in order to do this it will be requisite to make an opening in the bridge?—I think that an opening in the bridge is quite impracticable; and I do not think that it would be desirable to pull it down to build one with an opening, because, a great number of small vessels now

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 15th Oct., 1846.

MR. BREMNER.

in the lower harbour, where they are ill accommodated, and causing great crowding of it, would, with folding masts, be amply accommodated there.

Are you aware that the wall between the Timber Bridge and the Stockwell Bridge is only about 75 feet from the houses, and that great danger would result to those houses if the river at this place were to be deepened to an extent that would accommodate vessels drawing from 17 to 18 feet of water?—I should think so.

COMMISSIONER.—How much do you think it might be deepened with safety to the walls?—Eight or nine feet. I would not recommend such deepening as would be necessary for bringing up large craft, but deepening that would enable us to accommodate craft under 100 tons, say 9 feet at high water.

This space, we believe, is about 13½ acres?—It is.

MR. TURNER.—Yes; and the trustees have power to do that.

MR. M'LELLAN.—They have only power to build walls on the north side.

COMMISSIONER.—We are not aware that any one has proposed to bring large ships above Glasgow?

The LORD PROVOST.—No.

MR. CHAPMAN.—We have been told, in reference to the Newshot Isle, that the straightening of the river there would save a distance of 360 feet in the navigation of the river; now, I would wish to ask Mr. Bremner if there is no other part of the river which, if straightened, would save a greater distance.—Yes; there is a point at Over Newton or Kelvinhaugh; but it would not shorten the distance so much as at the Newshot Isle, because the distance at the former is small.

Are you aware, Mr. Bremner, that large steamers must go at a slow rate in rounding the acute angles of the river? Would the straightening of these not save as much as at Newshot Isle?—Perhaps they might, and more in point of time—not distance, however. As we were coming up the Clyde with Captain Washington, in returning from his inspection of the river yesterday, we encountered the "Fire King" steamer at one of these acute angles, which detained us five or six minutes in passing, it being then nearly dark at night.

COMMISSIONER.—What is the width of the channel at the Newsbot Isle?—310 feet.

MR. M'LELLAN.—What is the object which Mr. Cbapman is aiming at by his questions?

MR. CHAPMAN.—I wish to bring it out that Mr. Bald made a great point of this humbug improvement of the Newshot Isle, while he neglected that of the upper part of the river.

COMMISSIONER.—Could Mr. Bald have any interest in proposing that scheme?

MR. CHAPMAN.—Well, I do not know. Some may fancy that there is glory in a suggestion.

MR. M'LELLAN.—I cannot but express my regret at hearing the term "humbug" applied to this improvement, which I regard in a totally different point of view. In fact, I regard it as one of the most beneficial improvements that can be carried out.

COMMISSIONER.—Can you give us any statement regarding the dredging?—I will to-morrow.

What is the present harbour space?—The present harbour space is 21 acres. An additional space of 11½ acres will be added to the harbour when the walls are completed. Contracts are not taken for all that space.

When do you expect that this additional space will be added to the harbour?—In four years you may look for these 11 acres being added to the harbour; one half of it, I would say, in two years.

Do you consider that this additional accommodation is much wanted?—Yes; for I have seen, of small vessels, five and six tiers lying abreast in the harbour. The cartage will be increased by extending the quays to the westward.

In a former part of your evidence, you spoke about putting back the time of high water; can you say if there has been any alteration in the tide for the last few years?—The tide was accelerated twenty minutes between Port Glasgow and Glasgow, from 1824 to 1835; but from 1835 to 1845 it has remained much the same.

May not the rapidity of the tidal wave be increased by widening the river, and by making the throttling parts of an uniform width and depth?—It may. The river is quite level down to Dunglass: it is level for 10½ or 11 miles.

Do you feel satisfied with the authority by which you have to carry on the works?—Yes.

MR. M'LELLAN.—Have you suffered any annoyance in carrying on the works, or have you found it necessary to make any complaints?—In the operations of the harbour, I would like certainly to have more control over the foreman; but the subject is at present under the consideration of the trustees. I have found some little difficulty in ascertaining what one's duties exactly are; but I feel satisfied that this will be arranged.

Capt. JOHNATONE.

Captain JOHNSTONE, *Harbour-master*, examined.

COMMISSIONER.—How long have you been harbour-master?—Nineteen years.

During that time you have seen a great increase in the traffic of the harbour?—Yes; a great deal.

In any particular class of vessels?—In all classes; but particularly in large steam-vessels, and in large foreign vessels.

Is it the practice to berth vessels of a particular class on either side of the harbour; those for import on one side, and those for export upon another?—Yes; the import side is on the north, and the export on the south.

Do you not find a great pressure from want of harbour room?—The pressure has been felt for the last 19 years, and is still increasing.

Has any increase of accommodation been given during those 19 years?—A great deal on both sides, by both widening and lengthening the quays.

Will you state what in your opinion will be the best mode of increasing that accommodation?—I think, when the works contemplated, and at present going on, above and below the bridges, are completed, that we will have ample accommodation.

By the extension of the accommodation below the bridges, do you allude to the docks?—I refer to the present accommodation and the works going on.

Do you think, if the river were deepened and quayed above the bridges, that some of the small vessels would go up there?—Yes; I have no doubt that a great many would alter their masts for the purpose of going up to that place.

Do you attend the meetings of the trustees?—No; I only attend them when sent for.

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 15th Oct., 1846.

Capt. JOHNSTONE.

Have you ever reported the want of accommodation?—I have repeatedly represented it.

Do you hear many complaints about want of water for large steamers and foreign vessels?—Yes; often.

Would they go, do you think, to the proposed dock at Stobcross, or continue to come up to the quays?—I am of opinion that they would rather come up to the quays.

You are aware of the proposed General Railway Terminus Quay on the south side; suppose traffic to come up to it, would it not block up the harbour?—From a plan that I have seen, there is no likelihood of any jamming up of the harbour; at any rate, the extension will fully make up for any additional traffic.

Have you heard complaints from the masters of large steamers, as to the narrow parts of the river, and the difficulty of turning corners?—Daily complaints.

Do these complaints reach the Clyde trustees?—Yes; and, besides, there are many trustees who own large ships.

If the present improvements are carried out, do you consider that they will go far to remedy these defects?—Yes.

Do you consider it desirable that these should be hastened onward?—Very desirable.

Have you noticed any part of the quay walls having given way in the harbour?—Yes; a great part of them has given way, and likely to give way still more.

Is that the effect of the deepening of the river?—Yes.

Do you consider that they must be refounded, or secured in some other way?—Yes.

What is the present depth in the harbour?—We have at neap-tides about 15 feet.

Does any one sound the river to try the depth?—Yes; the engineer generally does this. I do it also for my own satisfaction, probably for three or four months.

Are you aware whether the engineer does it at stated times?—Mr. Bald used to do it frequently; and Mr. Bremner has done it two or three times since he came.

You have heard what has been said here to-day about the removal of the weir; do you think it would be of great benefit to the harbour to get rid of it?—Yes, I think it would.

To remove it higher up or get rid of it altogether?—To get rid of it altogether.

You are of opinion that it is desirable to encourage the flow of the tide as high up as possible?—Decidedly so.

There is a great expense in dredging incurred at present?—There have been five machines kept constantly going till this year; and there are four now.

Do you think that might be obviated if the tidal scour were increased?—Yes.

Do the freshes come down very heavy?—Yes, sometimes.

Do they do much damage to the shipping?—Yes; particularly when accompanied by ice. They break ships from their fastnings sometimes. In 1832, or thereabouts, 60 or 70 sail broke away and sustained a good deal of damage.

Seeing that this has been the case, would it not be desirable to make the dock at Windmillcroft?—Yes; for the ships lying with us in the winter time. These we are obliged to send to the harbour at Bowling.

Has there been any increase of small vessels in the harbour lately?—A little.

Can you state the whole arrivals and sailings during the past year, or for any period further back?—Of sailing vessels, the arrivals from July 1845 to July 1846, amounted to 5924, and their tonnage to 342,735. The arrivals of steamers amounted to 8485, and their tonnage to 775,233. The whole number of arrivals were 14,409; and the total tonnage 1,117,968.

Out of that number were there many that came into collision with each other?—Yes, particularly in the lower part of the river.

Was there much damage experienced?—I could not estimate what it may amount to. I have known damage to the extent of 60*l.*, 80*l.*, and even 100*l.*, done in the clap of a hand.

Can you give me a more detailed account as to the sizes of the vessels?—Yes. (See App. No. 352.)

Seeing that this damage arises, would it not be desirable to lay out a little more money in widening the harbour in these narrow places?—Yes.

I think you said that it was desirable to deepen between the bridges, and make a quay for small craft?—Yes.

What would you do with the timber that now lies there?—I think it could be placed so as to accommodate the vessels without any fear of their breaking adrift.

[Mr. M'LELLAN.—A report is just finished on this matter, and it will be brought before the trustees at their first regular meeting.]

Seeing that there have been so many complaints about this pressure in the harbour, was it not the duty of the trustees to have done what they could to remedy it?—A great deal of accommodation has been given since I was harbour-master; but we are never able to keep up with the trade.

Will you state the things to be done for the improvement of the river and harbour?—I think in the river the first thing to be done, is to cut off the quick bends, and to widen where necessary; and in the harbour, to carry out what is now contracted for. I am of opinion that this will be carried out without any more delay.

Are your duties clearly defined?—I have never come in contact with others.

Are you responsible to a committee of the trustees?—Yes.

Are the bye-laws properly exhibited about the harbour?—Yes, at regular distances.

Is there any want of mooring rings, cranes, &c.?—No.

How much is the largest crane calculated to be able to lift?—About 45 tons.

Mr. M'LELLAN.—The committee have authority to get a larger crane put up on the north bank of the river.]

Is fresh water led down to the quays?—Yes.

How do your ships get coal?—The coal is laid down on the quays, and then carted or wheeled into the vessels. The coal is taken into the small vessels with shoots.

Would you be in favour of laying rails for that purpose?—No; I think it would be injurious to have rails laid down on the quays where the general trade of the city is carried on.

Will there not be rails on the General Terminus Quay?—Yes; but I think that that part of the quay will be chiefly taken up by ships loading with minerals carried along that railway.

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 15th Oct., 1846.

Capt. JOHNSTONE.

You are decidedly of opinion that it is desirable to have accommodation as high up as possible?—Decidedly.

You would not, you say, make that accommodation to suit large sailing vessels?—No, because the inconvenience would do away with any benefit that would be derived from it. I think that the end would be equally gained by providing accommodation for small vessels. Large vessels would then be allowed to come up close to the lower bridge.

Mr. TURNER.—I would wish to ask Mr. Johnstone whether the trustees have not used their utmost exertions, on every occasion, to increase the accommodation by every means in their power?—I am not aware that they have not.

Mr. Johnstone has stated that when the trustees had finished the quays to the extent contemplated, there would be ample accommodation for the present trade; but I would ask if he does not know that they have acquired the grounds of Stobcross for an increased trade?—Yes.

Mr. BELL.—Why have the trustees not taken advantage of the Windmillcroft basin?—I would have carried it out had it rested with me.

COMMISSIONER.—Do you consider that the harbour should be of an uniform width?—Yes.

How far do you consider that width should go?—To Stobcross. I think the harbour should not be narrower than 400 feet.

Mr. F. GALBRAITH.—Are you aware that the trustees got power by the Act of 1840, to improve the harbour to a much greater extent westward then they have done?—I cannot well speak on that point.

What is the width of the harbour opposite Mr. Napier's Dock? And what is the clear space that is necessary for the canting of vessels?—It requires about 300 feet of clear space for canting vessels.

[Mr. BREMNER.—The width opposite Napier's dock, when the improvements shall have been carried out, will be 480 feet; it is now 210 feet.]

How many vessels are generally berthed in tiers?—There are sometimes only one, and sometimes seven or eight.

How much space would vessels of from 300 to 400 tons occupy?—A ship of 300 tons will take from 25 to 26 feet.

Whenever the harbour shall be extended westward at Napier's Dock, how many vessels do you expect will be lying there loading and unloading?—I do not think we will have more than two.

COMMISSIONER.—Would it be desirable to get the quayage at Windmillcroft, or to get it at the west-end of the harbour?—My opinion is, that the higher the traffic is kept to the city the better.

Do you consider that the number of vessels which are obliged to be abreast is the cause of most of the accidents which occur in the harbour?—That is a police matter, and does not come within my jurisdiction.

Are you aware that there have been 32 deaths from drowning, &c., within the last twelve months?—I cannot exactly say. I am aware that there have been a number of accidents.

[Mr. M'LELLAN.—It was stated at a public meeting that the number of deaths amounted to 43?

Mr. GRAY—No; it was stated that 43 people were taken out of the harbour, but they were not all drowned.]

Mr. G. W. MUIR.—I would wish to ask, since Windmillcroft has been abandoned, whether the trustees have made any experiments on the lands of Stobcross, to ascertain whether the ground is of such a nature as to be suitable for a wet dock?

Mr. JOHNSTONE.—I do not know about that.

Mr. BREMNER.—Borings were made before the Act was obtained, and the results were satisfactory.

Mr. M'LELLAN.—The trustees are not compelled to make docks; and as it is more than probable that they will make a tidal basin, it is not of much consequence what the nature of the ground is. I would like to ask Capt. Johnstone whether he considers that any portion of the harbour ought to be taken for railway purposes to the west of Glasgow Bridge.

Capt. JOHNSTONE.—I would not recommend a railway to cross below Glasgow Bridge. I would have less objection to crossing below Stockwell Bridge; but I would prefer that the crossing should be made above all the bridges.

Mr. GRAY.—Suppose a large sum were given as compensation, and suppose the railway bridge were to be raised 15 feet above the highest arch of the present bridge at Stockwell, would that not be sufficient to overcome Capt. Johnstone's objections to crossing below the Stockwell Bridge?—I dare say it might compensate for crossing at this point; but no money would compensate for crossing below Glasgow Bridge; and, if it were left to me, I would never agree to it.

Mr. JAMES RUSSELL, *Steam-boat Harbour-master*, examined.

Mr. JAS. RUSSELL.

COMMISSIONER.—How long have you been connected with the harbour?—25 years.

You have heard all that has been stated by Capt. Johnstone?—Yes.

Do you agree with him in what he has stated?—I agree generally with him in what he has stated. I find great want of accommodation in the harbour.

What do you consider the best mode of remedying that?—I think the works now in progress are on a good plan, and will relieve the harbour very much. I refer particularly to the additional quayage, and to the deepening of the harbour between the bridges, where I anticipate that many of the small craft would go.

Mr. M'LELLAN.—Do you not think that most of the small steamers, if this were done, would fit themselves with folding funnels.—Yes.

COMMISSIONER.—Are you in favour of the removal of the weir?—Yes; there should be no obstruction to the tidal flow.

Is the obstruction at Newshot Isle very detrimental to the tidal flow?—I cannot speak as to that; I would rather confine myself to the harbour.

Have you heard great complaints as to the sharp points in the river?—Yes, from all engaged in the traffic.

Do large steamers sometimes go aground?—Yes.

How could this be obviated?—It could be obviated by taking off the jutting points, and straightening the bends in the river. Frequently, at these bends, before a vessel will answer the helm, it is aground on some part of the river.

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 15th Oct., 1846.

MR. JAS. RUSSELL.

You heard it mentioned to-day that many accidents happen in the river?—Yes; but I cannot tell you the number.

Does any one keep an account of them?—I have charge of the police, and any complaints brought before the magistrates are recorded in the books.

Do you think that any accidents occur to the vessels themselves from the manner in which they are berthed?—Yes; they are sometimes chafed and otherwise injured.

Do you think that a wet dock at Windmillcroft would have been desirable if there had been no objections to it?—Yes.

Do you know what the objections were?—No.

Do you think that steamers would prefer the open harbour to an enclosed dock?—I think steamers would prefer the open harbour at all times. I am sure the river steamers would do so; and as to foreign steamers, I am not aware whether or not they would prefer going into a dock.

Would a basin at Govan be useful?—I do not know.

MR. M'LELLAN.—What part of the harbour is it where the river steamer trade is carried on?—Immediately below the Glasgow Bridge.

COMMISSIONER.—Might not all that go between the bridges?—Perhaps it might. I do not think, however, that any of the Rothesay boats could pass through the arches of the bridge, on account of their high paddle-boxes.

MR. M'LELLAN.—Are you aware that any attempt has been made to get this portion of the harbour for a railway bridge, and if so, do you think that it should be resisted?—Yes.

Would it not be a great advantage to the city of Glasgow if the steamers could go up the river?—Yes.

Have you any improvements to suggest?—None, except those going on.

Would you wish to see these going on faster?—The faster the better; I would be very glad to see them all completed.

MR. J. HUTCHISON.

JAMES HUTCHISON, Esq., *Manufacturer, Glasgow, and formerly Chairman of the Clyde Trust*, examined.

Will you favour us, Mr. Hutchison, with your opinions upon the harbour and river?—I think it is of great importance to extend the harbour to the full extent allowed by the Act of 1840, down to *Barclay's* slip, on both sides of the river. I am also of opinion that the extension of the harbour upwards to the Stockwell Bridge will be of great use to the trade of Glasgow, either with an opening or without an opening, in the Glasgow Bridge. An opening in the Glasgow Bridge would not startle me very much. I think that this would be preferable to making docks at Stobcross.

Both as a financial matter and with reference to the convenience of the trade?—Both. The docks at Stobcross would be attended with great expense, and they are beyond the means of the trust to accomplish. I am of opinion that the efforts of the trustees should be confined to the extension of the harbour, and the improvement of the bed of the river. The bed of the river is composed of stuff not injurious to the bottom of vessels, and the small rise of the tide does not inconvenience the trade in loading and unloading. These improvements would be more beneficial, and attended with less expense, than the making of docks.

Then, in your opinion, the trustees would not be warranted in making these docks?—Not at present; but I would have the bed of the river to be made, as far as possible, suitable for harbourage.

Would you have any objection to a railway crossing below Stockwell Bridge?—Yes; on the principle that the whole space should be reserved for the harbour.

On this principle you have a still greater objection to a railway crossing below Glasgow Bridge?—Yes.

Do you think that the weir at Stockwell Bridge should be removed?—We had great difficulty between the water companies and other parties to obtain the Act of 1840. These difficulties still exist to some extent, but I am of opinion that if a suitable supply of water could be got, it would be desirable to remove the weir.

Supposing it were proposed to carry a railway across the river above Hutcheson's Bridge, would you object to it?—I do not think it would hurt the navigation of the Clyde; but it might interfere with the rights of the citizens if encroachments were made upon the Green.

Do you think that the works carried out on this harbour are at all equal to the large expenditure that has been incurred, there having been about a million of money altogether laid out?—It is a difficult thing to say whether it has been all advantageously laid out or not. I have, in my own experience, seen nothing glaring; there has been an enormous outlay in procuring ground on each side of the harbour.

Are you aware that some of the quays have been giving way?—I think that the engineer was mistaken as to the strength of the foundation of the quay on the south side. About 200 feet of it had been built by Mr. Atherton when he resigned his office. Mr. Logan was appointed in his place. He examined the piling, and he said that he thought the piling was much too slender for the quays; and he stated that he would recommend additional piling, to make the quays such as he thought would stand. The quays which Atherton made have given way, as well as some of Mr. Logan's.

How long were you a Clyde trustee?—I was a Clyde trustee from 1832 to 1842.

You are aware that the trust has been put to great expense in applications to Parliament for Bills?—Yes, to very great expense.

Do you think that that money was imprudently expended?—No; it could not be avoided. A very large expense has been incurred in these applications to Parliament; I think about 20,468*l.* has been in all expended.

Do you think that it would be useful to have some Government Board established, to assist in carrying your Bills, and to do away with this enormous expenditure of money?—Yes, I think it would be necessary.

Do you think that some such Board might be organized, and be of great use in the management of the river?—I think it would be a great advantage to have such a Board, which would prevent expense, and otherwise be of much service. Had it not been for the interference of the Admiralty in 1845, the harbour would have been ruined by several parties; and therefore I think that if a Board were established in connexion with the Admiralty, which would have special charge of the rivers of the kingdom, it would be a great advantage to such a harbour as that of Glasgow.

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 15th Oct., 1846.

Mr. J. HUTCHISON.

Have you formed an opinion in regard to the Newshot Channel?—It was a subject which excited a good deal of discussion when I was chairman of the trust. Mr. Bald had a high opinion of opening the south channel, but I could not agree with him, as I was of opinion that the present channel should be improved on the plan laid down by Mr. Logan and supported by Mr. Walker.

Mr. M'LELLAN.—Was the expense the sole object of consideration?—No; not at all.

What are your objections to this channel?—The channel commences at the junction with the Cart. By the junction there the bend is useful, for if you were to make it straight, it would be an awkward entrance for the River Cart into the Clyde.

Do you know the capacity of the channel of the Clyde above the Cart, and the capacity of the channel below the Newshot Isle?—I could not speak precisely as to the difference, but I think it must be considerable.

COMMISSIONER.—Do you think it necessary to employ more dredgers?—I do not think it; but I think the trustees have neglected cutting away the points in the harbour above Whiteinch.

Are many of the Clyde trustees sailors?—I cannot say that any of them are sailors.

Lord PROVOST.—As Mr. Hutchison has given in his strong adherence to this Board of Control, I would wish to ask him if he has seen the new Bill, and would like to be under the management of a London Board?—I have not seen the Bill, but I have seen some extracts from it. I do not approve, perhaps, of all the scheme, but I approve of a Board that would assist in lessening the expense, and which should be consulted when large works were to be done.

You would not allow this Board to appoint harbour-masters?—No; but I am decidedly of opinion that such a project as the construction of new docks should not be permitted except with the assistance of such a Board as this.

Mr. M'LELLAN.—Mr. Hutchison is perhaps not aware that this principle is recognised in the last Act obtained by the Harbour Trustees. Such works cannot be commenced without taking with us two Government Boards,—the Lords of the Admiralty, and the Commissioners of Woods and Forests.

Mr. GRAY.—You state, Mr. Hutchison, that we were indebted to the Admiralty for preventing the aggression of railway companies upon the harbour; are you aware that the Admiralty allowed the West of Scotland Junction project to go to a committee of the House of Commons?—What I alluded to was in 1845. I alluded to what is well known, that the committee would have passed the Bill of one of these projects in 1845 but for the strenuous interference of the Admiralty.

Are you aware that the West of Scotland Junction Bill was thrown out on the evidence submitted to the committee, and not on the interference of the Admiralty?—Yes, I believe that to be the case.

COMMISSIONER.—Why did the Admiralty not attend to this matter?

Mr. GRAY.—They attended very properly to it; but what I stated was, that while the interference of the Admiralty was most decided on the 24th of February; and again in the beginning of March, they, notwithstanding, on the 16th of March, allowed the Bill to go to a committee. We are therefore indebted not to the Admiralty for saving the harbour from this invasion, but to Lord Worsley's committee.

COMMISSIONER.—If any conclusion may be drawn from this circumstance it is this, that a separate Board, which has not its hands filled like the Admiralty, and whose duty it would be to attend to such matters, is necessary.

Mr. GRAY.—The Admiralty have full powers to take the opinions of any one if they have not time to attend to it themselves. I am also of opinion, that if the Tidal Commission had been in existence, on the occasion to which I referred, our expenses would not have cost us a penny less than they had done.

Mr. CHAPMAN.—Instead of the Admiralty not having information as to what was about to take place, I may mention, that Lord Ellenborough told us that he thought it should not be decided by the Admiralty, but that it should go before a committee of the House of Commons.

Mr. M'LELLAN.—I have to state, as my opinion, that it arose from the enormous pressure on that huge engine the Board of Admiralty. I must say, that I would look upon the assistance of a Government Board as a very great blessing. As the exact extent of the works at present in progress has not been stated, I beg to give the following detailed statement:—(See App. No. 351.)

COMMISSIONER.—Can you tell, Mr. Hutchison, the reason why the basin or dock at Windmillcroft was relinquished?—I have heard statements made that it had been relinquished in consequence of a report by Mr. Walker. No such report was given in by Mr. Walker, or asked from him. It was resolved, by the unanimous opinion of all the trustees, except one, to give it up, on the report of Mr. Bald. That was the cause why it was not done. It was considered that it would require an enormous expense to consolidate the ground, which was spungy, and full of running mud; and hence they decided against the project. I think it is a very fortunate thing that it was not executed. There are about 10,000 or 12,000 yards of that ground applied to the purposes of the harbour, so that there will be between 40,000 and 44,000 yards which remain undisposed of in the hands of the trustees.

Mr. TURNER.—Mr. Walker is not prepared to say that it should not be made into a dock. He thinks it is an admirable place for a graving-dock. Looking to the enormous increase in the shipping, he thinks that no ground, situated as that is, should be disposed of; and hence the trustees retain it in their possession.

COMMISSIONER.—Is there any patent slip in the harbour?

Mr. HUTCHISON.—There is a private one (Barclay's).

Mr. CHAPMAN.—We have to send our heavy ships to Liverpool to be repaired, which is attended with great expense and inconvenience.

Mr. M'LELLAN.—The Clyda trustees have felt this for many years.

Mr. CHAPMAN.—When the trustees were last before Parliament, I urged them to take powers in the Bill for making a graving-dock, but they would not consent to do this.

(*Adjourned till Friday.*)

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 16th Oct., 1846.

MR. D. BELL.

Friday, October 16, 1846.

Examining Commissioner, Captain WASHINGTON, R.N., assisted by Captain BETHUNE, R.N., C.B.

COMMISSIONER.—We closed the proceedings yesterday by adjournment at the moment when Mr. Bell was about to give his evidence; we will now, therefore, call upon that gentleman to state his opinions on the subject under inquiry. You were at one period a member of the Clyde trust, Mr. Bell?—I was a Clyde trustee for about ten years, a member of town council for five years, and for sometime deputy-chairman of the committee of management.

You have expressed your disapproval strongly of the management of the Clyde trustees?—I was extremely opposed to the trustees going to Parliament in 1836 for a new Bill, and moved in the trust, and gave my reasons for it, "That, anxious as the trustees were as a body to improve the harbour, it was inexpedient at that time to go to Parliament." Afterwards, not wishing but to have great improvements, I went hand-in-hand with the other trustees for a Bill; and although I was not one of the committee of management, I transmitted a document suggesting the improvements which I thought were necessary, and wishing to limit the extent of borrowed money. At that time there was considerable discussion amongst the trustees, some of whom wished to alter the constitution of the trust. The trust then consisted of the town council of Glasgow, which was 32, and, by the Act obtained in 1826, of five merchants belonging to the city, who were annually elected by the corporation, and I formed one of those five. A number of the trustees were not satisfied with the constitution; but I maintained that it was the best we could get, with this single exception, that the number of trustees not members of the town council should be six instead of five, and that they should be elected for three years instead of annually (two to be elected each year), but at the same time I did not think it was proper to go to Parliament for that purpose. There was a great difference of opinion in the trust likewise about the extent of the accommodation required; and from returns which I procured of all the foreign shipping entering the Clyde, exclusive of what came to Glasgow, and after allowing for a moderate increase, I found there was no great necessity for such extraordinary accommodation. Under these circumstances I gave notice that "It was inexpedient to go to Parliament." Nevertheless the trustees did go to Parliament; but it having been decided in the committee to which the Bill was referred, on the motion of Sir William Rae, that the whole public interests of the city should be represented in the trust; in consequence of that vote the Bill was withdrawn.

Is not this travelling over ground which will do us little good? You had better, I think, confine yourself to whether there is actually anything wrong in the present constitution of the trust?—

MR. BELL.—By Act of Parliament the alveus of the river was the property of the trustees, *pro bono publico*, invested in them by the legislature, not only for navigable purposes, but for discharging the surplus water of land floods, upon which it was their right and duty to prevent encroachments, and which they were entitled to resume when required. Now I want to show, that previous to the Act of 1840, the Clyde trustees had a right to improve and resume the ground which was then recognised as the property of Tod's trustees. A case in point was decided by the Court of Session, and confirmed by the House of Peers.

Then do I understand you to say that the 52,000*l.* paid to these parties was unnecessary?—Not with respect to that, for that was paid for his works.

Then what sum was improperly paid?—The first I complain of is the sum of 8000*l.* which was given to Mr. Robert Napier, on account of alveus ground, and without a jury trial; next, that a large sum of money, 5560*l.*, was given to Mr. Alexander Johnstone, for the ground immediately below that, besides expenses; and then that 12,000*l.* was given to Mr. Hardie's trustees for the water-side ground next to Mr. Johnstone's. Besides these sums large sums of money have been paid for water-side ground on each side of the river, and which, but for the clauses inserted in the Act 1840, in favour of private parties by the trustees' consent, would have been resumed *gratis*, as forming part of the alveus of the river, and as such the property of the Crown or Admiralty, or the River Clyde trust, as representing the public in their behalf.

You are of opinion that all that was alveus, and belonged of right to the public?—A great deal of it. There was likewise Finnieston water-side ground. When the proprietor feued out that ground, the water-side space was left, and I have seen it covered twenty times with floods. It never yielded anything but grass (and was only used for bleaching a few clothes), and the Clyde trustees paid to these feuars 23,000*l.*

When was this paid?—Two or three years ago.

This does not appear in the list of sums paid for ground by the trust within that period?

MR. TURNER.—It is entered under the head of "William Niven and others." Only a portion of the ground referred to by Mr. Bell was alveus.

MR. BELL maintained that it was all alveus; and what he understood by alveus had reference not only to the tide running up, but to the transverse section necessary for land-water coming down.

MR. TURNER.—The last Act of Parliament defined what alveus was to be, the space so fixed being that within the plan of Mr. Kyle, made in 1800.

MR. BELL.—I mean to say that by adopting that plan the rights of the Clyde Trust were sacrificed.

COMMISSIONER.—Do you acknowledge that this plan of 1800 is recognised in the Act of Parliament?

MR. BELL.—Yes, I acknowledge it; but the alveus had been narrowed before that, viz. from 1758 and 1770. I believe it went up to the road, on each side of the river. The Clyde Trust sacrificed the public interest in 1840 to get their Bill passed, because they were threatened with having to pay the expense of 7000*l.*, which they had incurred in 1836, when they did not get an Act of Parliament, and other parties' expenses if they did not get a Bill in 1840. By alveus I understand not only tidal alveus, but also the necessary section of river requisite for land-floods or drainage of the waters coming down. Now, as the clear water-way of Hutcheson's Bridge at Glasgow, *exclusive of piers*, is about 360 feet, and that of the other two bridges at Glasgow is about 370 feet and 390 feet respectively, I contend that that amount of water-way is necessary for the drainage of the upper country. Farther, I contend that the tidal alveus, before the trustees commenced their operations by constructing dykes and jetties, was ample as respects width for all necessary river improvement purposes. In 1840, when the Act was passed, a clause was passed by the House of Commons in order to enable the River Trust to enter upon the possession of the water-side ground in a manner the least expensive, without the expense of ordinary titles; but that clause was abandoned, on the pretence that Lord Shaftesbury

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 16th Oct., 1846.

Mr. D. BELL.

would not allow it to go into any Act, on the ground that it would interfere with the stamp duties. The observations made by Sir William Rae in committee, whilst the Bill of 1840 was pending, as to the 7000*l.* spent and charged by the River Trust in their accounts, was, in my opinion, a principal cause why the Act of 1840 was proceeded with, as the trustees (or rather the deputation of them then in London) agreed to insert various clauses in the Bill highly detrimental to the well-being of the River Clyde Trust, and against which clauses, I, individually, and at my own expense, petitioned the House of Lords after the Bill had passed the Commons. The trustees spent about 12,000*l.* in passing the Act of 1840. [Mr. Bell then referred to his petition to the House of Lords against the Bill of 1840, a copy of which he produced.]

Clyde Navigation Bill.

To the Right Honourable the Lords Spiritual and Temporal of the United Kingdom of Great Britain and Ireland, in Parliament assembled, the humble Petition of DAVID BELL, Merchant and Steam-boat Owner, in Glasgow, and one of the Parliamentary Trustees for Enlarging the Harbour of Glasgow, and Improving the Navigation of the River Clyde,

SHEWETH,

That a Bill is now pending in your Lordships' Honourable House, entitled "An Act for further deepening and improving the River Clyde, and enlarging the Harbour of Glasgow, and for constructing a Wet Dock in connexion with the said River and Harbour," in which powers are taken to borrow 300,000*l.* *in addition* to nearly 200,000*l.* now owing by the trust; to charge additional powers on the trustees. That, in your petitioner's opinion, the said Bill is not only unnecessary, but would be injurious to the true interests of the river and harbour if passed into a law.

That as the powers vested in the trustees are sufficient for all necessary purposes of the trust, and by no means exhausted, it would be improper to confer additional powers on the said trustees.

That the River Clyde trustees, in 1836, under the pretence of their Parliamentary powers being exhausted, applied to Parliament for a Bill; which Bill was withdrawn after a waste of 7000*l.* of the trust funds.

That the annual revenue of the trust for the year ending 8th July, 1839, was 45,826*l.*, which large and increasing revenue is amply sufficient to accomplish every requisite improvement, not only of the river, but of the harbour, without having recourse to borrowing any sums of money whatever beyond what is now authorized by Parliament.

That by the said Bill it is intended to relinquish and abandon in favour of private parties various large and valuable tracts of land or "frontages" to the said River Clyde, which land is the property of the Crown, subject to the powers of resumption by the trustees for the purpose of the navigation, part of which reclaimed lands have been of late claimed by the adjoining proprietors, but which claims have been decided by the Court of Session in Scotland to be invalid; notwithstanding of which, the Clyde trustees and those parties or "frontagers" have introduced into the present Bill clauses or provisions for conceding to the "frontagers" one moiety of the value of the lands so reclaimed by the trustees, thereby totally disregarding the rights of the Crown, and sacrificing the rights of the public.

That the clause to which the petitioner particularly refers is clause nineteen of the said Bill, which enacts, that from and after the passing of the Act, the lands outside the line of the works authorized by the Bill,—such lands not being to be taken by the Bill for the purposes of the works,—shall be the property of the individuals named in the Bill; and the petitioner contends that it is not competent, at least it is not regular, according to sound principles of legislation, or to the practice of your Lordships' honourable House, in a Bill for authorizing a particular work, to declare anything with respect to the title to lands not required for that work, or in an instance to permit a Bill effecting estates in land, or heritable subjects in Scotland, to proceed until the matter thereof shall have been inquired into, and reported upon by the Judges.

That your petitioner ever has been, and ever will be, decidedly in favour of widening, deepening, and improving the navigation of the River Clyde, and enlarging the harbour of Glasgow; but that until such times as certain actions at law, now pending, are decided, and until the trustees convert the great space between the Glasgow and Stockwell Street Bridges to river and harbour purposes, no additional powers should be granted to the said trustees.

That the general width of the harbour below Glasgow Bridge, as far down as the quays extend on both sides of the river, is 380 feet; whereas by the plan now submitted, it is intended to extend the harbour further westward, and away from the city, and to make such part 480 feet wide, which great additional breadth would occasion an immense annual extra expense in dredging and cleaning out the increased depositation of soil and sand, which thereby would be occasioned.

That your petitioner is decidedly of opinion that the trustees should not be authorised to form additional wharfs to the west of the steam-boat quays till the trustees shall have converted the field of Windmillcroft (now the property of the trust) into a wet dock or basin, to accomplish which the present annual surplus revenue of the trust, *with good management*, is amply sufficient.

That your petitioner observes with surprise that, although the trustees, by their estimates and plan, show an expenditure to be incurred of nearly a million of money, they mean to abandon the ancient and straight channel of the Clyde to the south of the Nushat Isle, which channel is much shorter than the crooked and circuitous one now in use; thus sacrificing much tidal space which is essential to the scour of the river throughout.

That a railway is now forming, and nearly completed, from Glasgow to Paisley, Port Glasgow, and Greenock; and that another railway is nearly completed between Glasgow, Paisley, Ardrossan, Irvine, Troon, and Ayr, from which most important results will follow as to the mode of communication between Glasgow and the various watering places and the other towns on the Clyde, and also with England and Ireland; consequently it would be imprudent and reckless to burden the trust with additional debt in the face of the severe competition from cheapness and greater expedition of transit on parallel railways.

That the dock, or inlet, adjoining the harbour of Glasgow, belonging to Robert Napier, is entirely excluded from the Bill, and the trustees have no power, without Mr. Napier's consent, to acquire the same for river or harbour purposes; and that, in consequence thereof, the water-side grounds belong-

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 16th Oct., 1846

MR. D. BELL.

ing to Mr. Alex. Johnston, to Mr. Gavin Hardie, and to the feuars of Finnieston and others are, in effect, also excluded from the Bill.

That the trustees, by the Bill, are prevented from lowering the weir at Glasgow Bridge; and that no powers have been taken in the Bill to place a weir in place of the same, at any part of the river higher up. That in consequence of this, the great space between Stockwell Bridge and Glasgow Bridge will be rendered unavailable for harbour purposes.

That by the said Bill the river trustees have become bound to purchase the whole of the works at Springfield, belonging to the late Mr Charles Todd, within six months after the passing of the Act.

That the said trustees are debarred from taking, by jury valuation, the remainder of Mr. Todd's ground, behind the said works to the Paisley road, should they think proper to do so.

That the river trustees by the Bill, should it pass into a law, are prohibited from using the tracking path on the south bank of the river from Glasgow to Renfrew, and which may eventually lead to the relinquishment of the footpath also.

That the revenue has been greatly reduced by the Bill, and that partially and unjustly.

That the shed dues will be partially relinquished, and that the said shed dues have been re-enacted, and rates are to be charged double what has been done for many years, and double what is levied at present.

That it is injurious to the interests of the river and harbour greatly to increase the debt of the trust, and greatly to diminish the revenue, which will be done by said Bill should it pass into a law.

That quays are unnecessary below Mr. Napier's dock on the north side of the river, or the Kinning House burn, on the south side of the river, till wharfs be made betwixt the bridges, and the wet-dock in Windmillcroft be completed.

That a clause has been introduced into the bill declaring the town clerks clerks to the trust for life, or if changed, that compensation should be made them.

That the trustees, by the Bill, are prevented from dredging between Dumbarton Castle and Port Glasgow (should they consider it necessary) till a certain chart of the Firth of Clyde be executed from Gourock upwards; and from deepening the river generally to more than thirteen feet at neap-tides, till all the harbour and dock improvements are completed.

That the present Acts are quite unclogged with clauses in favour of the proprietors along both sides of the river, excepting in favour of Lord Blantyre, while the present Bill creates, in the face of the decision in Mr. Todd's case, rights of property, and protecting clauses to which they are not entitled, in favour of every proprietor on each side of the river, from the harbour down to Dumbarton Castle.

That these new rights of property and protecting clauses will obstruct the river trustees in all their operations for improving the river and harbour, and absorb a sum of money greater in all probability than would be sufficient for carrying out, to their completion, the whole improvements contemplated by the present river Acts or by the present Bill.

That the promoters of the Bill have now under their own hands given another proof that there is no necessity to go to Parliament for new powers—for in the Bill by which they induced a majority of the trustees, and also a part of the public, to concur in their present application for new powers, they expressly took powers to form jetties, or connecting dykes, to the west of a line drawn from Dumbarton Castle on the north to West Ferry on the south, and on both the north and south sides of the river, down to Port Glasgow;—these new powers they have now abandoned, and confined themselves to the mere operation of dredging, from Dumbarton Castle downwards, which their present powers enable them to do,—thus proving that the preamble of their Bill, viz., the necessity of new powers, is not true, and is falsified by its own clauses.

> Your petitioner, therefore, humbly prays that the said Bill may not pass into a law, and that your petitioner may be heard by himself, his counsel, agents, and witnesses, against the preamble thereof, and such other clauses and provisions of the same as affect your petitioner's interest, or that he may have such other relief in the premises, as to your Lordships' right honourable House shall seem meet.
>
> And your petitioner will ever pray.

DAVID BELL.

[MR. BELL stated that this petition was presented to the House of Lords after the Act of 1840 had passed the Commons; and that he, Mr. Bell, had appeared in person in opposition to the preamble of the Bill before both the Committees of the House of Lords and House of Commons, but was unsuccessful in throwing out the Bill. Clauses were conceded to nearly all the opponents of the Bill (including the waterside ground proprietors) by the promoters to obtain an Act of any kind to carry the expenses incurred.]

COMMISSIONER.—Is there any other point of mismanagement?—I am of opinion that the river trust, when I was a member of it—and I can say it from experience—had not what I would call a government. It was without any official person at its head competent to the duties of such a trust, where such large revenues were at stake; and there was no manager or other person to take the initiative.

Can you suggest any better constitution of the trust than at present?—Any constitution would be better than the present.

Would you like to see more shipmasters and sailors in it?—I think that the influence of the steam-boat interest in the trust has been positively injurious to it, inasmuch as I believe that Windmillcroft has not been turned into a dock or basin, because the steam-vessels would not get any benefit from it; although it would relieve the harbour, and give accommodation in the basin to merchant sailing-vessels.

Are the dues chiefly derived from steam-vessels, or sailing-vessels?—I think, as near may be, taking the cargoes and hulls of vessels, about one-half each.

Do you think the present trust too numerous?—The members are not too numerous, if they do their duty; and, I must say, it could not have been in better hands, had the affairs been conducted according to Act of Parliament previous to that of 1840. But I have not turned my attention particularly to that subject. [See Appendix No. 348.]

Leave then the constitution of the Board, and point out where there is a want of harbour accommodation, and what improvements are necessary to afford greater facilities to the shipping passing up and down the river?—It was proved, in reference to the Bill of 1840, that there was relatively a greater want of harbour accommodation than of river accommodation; so much so, that a stringent

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 16th Oct., 1846.

Mr. D. BELL.

clause was introduced into the Act of Parliament to oblige the trustees to execute the harbour works first.

Do you think that a beneficial clause?—Most decidedly, if it had been acted upon, as intended, and in good faith.

If it has not been acted upon, have river improvements been executed in preference to harbour improvements?

Mr. TURNER.—That clause is repealed; it is not now in existence.

Mr. BELL.—It was a good clause; but it was rendered nugatory, not being acted upon. It was proved in Parliament, by the harbour masters and others, that there was no way by which the harbour would be so cheaply and expeditiously relieved and improved as by taking advantage of the space between the bridges for small craft, and of the Windmillcroft for a dock or basin; and I am ready to give my opinions why the basin was delayed so long.

You were not at that time a member of the trust?—I was.

Was the subject taken into consideration?—Repeatedly.

Why was it not carried into effect?—They called the upper navigation a bore, and resisted commencing operations; and, although I had been insisting upon its importance for 20 years, as a member of the trust and as a citizen, it was not till Mr. M'Lellan came into the trust that, by his influence—for I give him great credit for it—they made that little bit of wharf above the bridge with considerable reluctance. And now there are to be seen five, six, and eight vessels lying abreast at it, with distillers' grains from Campbelton and Islay, taking in coal, at great trouble, in buckets, instead of being ranged alongside the quay, as they ought to be. I think the quay wall should be graduated in height, and made lower as it approaches Stockwell-street Bridge; and I am quite of opinion that the upper harbour ought long since to have been deepened and quayed.

With respect to Windmillcroft?—Mr. Bald made plans, and bored it; and I happened to see that gentleman to-day, when he assured me that his boring extended to 100 feet down, and that there would be no difficulty to form a dock or basin on that ground. I believe he gave in a report to the trust on the subject, but which was discountenanced. It was his duty to suggest any improvements which he might consider necessary.

But he did make a report?—He did; and the trust discussed the matter again and again; and at a meeting held in the Portico Room of the Royal Exchange, I proposed that the examination should be begun in the first instance, but that was strenuously opposed—at a time, too, when the Glasgow and Ayrshire Railway Company were willing to take some thousands of cubic yards of the soil, to form their embankment at Glasgow, and near to the spot.

What is the general opinion as to the want of accommodation?—It is quite notorious that the vessels are sometimes five, six, and seven abreast. If the Windmillcroft basin had been executed, it would have accommodated—allowing every vessel to remain in dock a month—about 1000 square-rigged vessels annually, or 240,000 tons of shipping, being three times the whole tonnage from foreign parts entering the Clyde, excluding the vessels in the timber trade. Now, the harbour-masters stated deliberately in evidence, that the erection of that dock or basin would be of far greater service than the making of wharfs below Napier's Dock, on either side of the river. Mr. Bald has stated, that there would be no difficulty in forming it into a tidal basin, with quay walls as deep as the present quay walls in the harbour, and as easily, the subsoil being the same. I wish this to be particularly noticed—what both the harbour-masters stated in evidence, that there should be no additional wharfs whatever made in the stream further down until that dock or basin were excavated, and the accommodation exhausted between the bridges.

You are of opinion, with the harbour-masters, that the trust should give facilities for bringing the trade as far up the river as possible?—Most decidedly so. The further the trade is brought up the river the sooner the steamers would get clear of the sailing-vessels, and "get on," which would greatly lessen the risk of collisions, as well as the number of accidents in the harbour, besides saving in cartage an amount as great as the harbour dues. Everything in respect to the supply of life-buoys at the harbour could not be better than at present.

You have said, with respect to the Windmilcroft, that, in the opinion of Mr. Bald, a tidal basin there would be far better than extending the quays?—I will not say so for Mr. Bald, as he may have altered his opinion to please his employers.

Mr. BELL was proceeding to make some statement about the number of persons drowned in the harbour, when

The COMMISSIONER said he had got official returns of the number of persons taken out of the harbour during the years 1845 and 1846, from which it appeared that in 1845, 47 persons were taken out, 21 of whom were drowned and 26 recovered; and that in 1846, 44 were taken out, of whom 21 were recovered and 23 were drowned. Of the males mentioned in the return, Mr. Russell said, the greater part were seamen, but he had no means of ascertaining what proportion of them were drowned in the harbour.

Mr. JOHN ROBERTSON asked how many persons were drowned in the harbour in consequence of the steam-boats passing amongst the other vessels?

Mr. RUSSELL said he was not aware of any having directly happened from that cause.

COMMISSIONER.—You are not aware that many of these accidents occurred on account of the crowded state of the harbour?—Not to my knowledge.

COMMISSIONER.—Will you proceed Mr. Bell?

Mr. BELL said he had prepared a memorandum, which he would read, in regard to Glasgow Bridge. That bridge had been contracted for at a width of 52 feet, and he claimed the credit of having got a new contract entered into, for making it 60 feet, as it now existed. He looked upon Glasgow Bridge to be, relatively to Glasgow, what London Bridge was to London—in respect to locality of position and to the trade and importance of the two cities; and that even if it were practicable, which it was not without rebuilding that bridge, to make an opening in it for a drawbridge, to let vessels up and down, and though it should cost no money whatever, he would say such a measure would be altogether inexpedient, in consequence of the great intercourse between the two sides of the river. Even although it were to be opened at no expense, the advantages would be more than counterbalanced by the disadvantages. He held that it would be inexpedient, under any circumstances, to make an opening in that bridge.

Would you allow a railway bridge to be made below it?—I am of opinion that it would be as inexpedient to make a crossing below Glasgow Bridge as it would be to make one below London Bridge.

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 16th Oct., 1846.

Mr. D. BELL.

It is my decided opinion, that no railway company should get a right to cross the river below that bridge.

Would you, with reference to that point, explain where a bridge could be erected with least disadvantage to the Clyde navigation?—My clear opinion is that, provided the railway bridge were made with sufficient width between the arches, as wide as those of the Glasgow Bridge, and somewhat higher, there was no reason whatever why such a bridge might not be made anywhere betwixt the bridges, or at any other part of the river higher up. There was not the least danger of the piers of the railway bridge preventing the full tidal scour.

Are you of opinion that the weir should be removed?—In reality, there was now no weir, but an embankment of stones made to keep up the head level of the water for the Water Company, and to maintain the old bridge of Glasgow, at Stockwell-street. I am clearly of opinion that it is desirable to give the utmost freedom of scope to the tide to descend and ascend above all the bridges. At the same time, if I had the weir to reduce, I would do it gradually, the banks of the river being of an alluvial nature. With respect to the river below the harbour, I do not think it is desirable to widen the navigable channel to the extent of the Parliamentary lines on account of the great expense of it, and extra dredging that would be required. Where the river way is only 200 feet broad, I would increase it and make it from 260 to 300 feet; and gradually increase that width downwards to the mouth of the river at Erskine Ferry or Dunglass.

Have you heard any complaints of the want of width in the river?—I have heard frequent complaints on this subject, especially in regard to the space from Renfrew upwards, and particularly at the sudden bends. Below Renfrew, that point at the north of the Newshot Isle should be cut off according to the Parliamentary line. I approve of the Parliamentary plan in that respect. It was stated by Mr. Hope, the present Lord Justice Clerk, that the trustees had the power to take down Mr. Campbell of Blythewood's house, if the public interest required that the river should be widened to that extent, so ample were their powers under the old Act of Parliament. I think that the south channel at Newshot Isle should be opened. In my opinion, it would not hurt the other, and even if it should, it could be closed again. The opening of that channel would allow a greater tidal flow up the Cart, and I think it is important to preserve that tidal scour for the banks below Newshot Isle. Immediately above the Newshot Isle, the river Cart joined the Clyde, and up this river the main river Cart (running up to Paisley), was joined by two other rivers, the river Gryce and Black Cart, up all which rivers the tide flowed for several miles; and this was an additional reason why the south channel of the Clyde, at the Newshot Isle, should be opened and kept open. There was a bad bank below Bowling, which put the trustees to a good deal of expense in dredging. I approve of parallel dykes as far down as Erskine Ferry on the left bank, and Dunglass Castle on the north bank. I approve of the half-tide dykes being raised, as vessels are apt to get upon them and break their backs; but I am of opinion that these dykes should be removed altogether, or put much further back, and this should be done immediately by contract.

Does any damage occur to shipping at Port Glasgow, or by sandbanks?—I have not heard of any vessels being damaged or detained since the bank at Port Glasgow was cut away by Mr. Bald. The width of the river at Dunglass Castle was 410 feet. The late Mr. Rennie, father of Sir John Rennie, laid down the width at that point at 536 feet, but now it was only 410 feet, thus forming a gut which prevented the flow of the tide. He thought the dykes should be set back, so as to give the greatest width as soon as possible. I do not recollect how long it is since the parallel dykes were built up to high water, and I never gave my sanction to its being done.

Mr. BREMNER explained that the width intended to be now made was 600 feet, between Dunglass Castle and the mouth of the river, by setting back the dyke.

Mr. BELL.—In my opinion, the gut at Dunglass Castle prevents the tidal flow, and gives less tidal water at Glasgow Bridge, particularly at neap tides.

Mr. BREMNER explained, that the rate of the tidal wave upwards did not exceed 8 miles an hour, between Dunglass and Renfrew.

Mr. BELL.—I did all I could to induce the river trustees to increase the slope of the parallel dykes, but they would never agree to it. They did it however silently, when they built a new dyke at Mr. Smith's, of Jordan Mill's property; and, on this occasion, I believe they followed the example of the Paisley people, in doing it up the Cart. He objected to the angle of 45 degrees for the river side dykes, that is a slope of 1 in 1, and preferred now the slope to be 1 in 2, from the greater rise and fall of the tide. If the dykes were removed, they would soon widen the river by the dredging machines and the tidal scour.

Would it be desirable to make a tidal basin or dock at Stobcross?—It would be a direct benefit to the railway companies, and the result would likely be similar to what took place on the formation of the St. Katherine's Dock, causing the East and West India Docks to be deserted. He agreed with the evidence given yesterday, that all the trade should be brought up as far as possible. The cartage to Stobcross would be more than the whole harbour and river dues. Rather than have sanctioned the quays now being formed so far down the river, or making a dock or basin in the lands of Stobcross, I would have seriously considered as to taking down and rebuilding the Glasgow Bridge, at Jamaica Street, to let up large merchant craft; at all events, no quays should have been made farther down than Napier's Dock on the one side of the river, and the Kinning-house Burn on the other side, till the accommodation between the bridges for small craft; and the Windmill dock or basin for large craft were found insufficient, and such was the understanding of Parliament in 1840.

You are aware of a certain General Terminus Railway Company having obtained the right to 1200 feet of the harbour on the south side, do you approve of a private company having a right to the quays and frontage to that extent?—If it were confined to minerals I should have less hesitation, but I am of opinion that the river trustees should have opposed that, and encouraged the proposal of bringing the railway to the Windmillcroft basin, and as the mineral harbour below that again would have been more advantageous to the river as respected the shipping of coal and iron, I think the proposed mineral terminus, near Govan, would have been better for the interests of the harbour. I do not think there will be so great a traffic in minerals as was expected.

How far can you go above Glasgow Bridge with a barge drawing three to four feet of water?—With spring tides they could get up, perhaps, three or four miles above Glasgow Bridge, with barges drawing from four to five feet of water; and I think it would be desirable to encourage barges to go higher up the river, and to give every facility to river traffic. I would remove any obstacle both to the traffic and the river and to the flow of the tide.

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 16th Oct., 1846.

Mr. D. BELL.

Then you are of opinion that the river should be widened and deepened?—I would begin, if not in this present month of October, at least, as soon as possible, to put back the parallel dykes. I would likewise straighten the river as much as possible at the entrance of the Leven, near Dumbarton Castle. I would take away the Garmoyle Lighthouse and put it on the line of the river. The light was necessary where it was at present, but I would dredge the bank, and then alter the position of the light. I have nothing to say about the other light, only I thought a light might be placed somewhere in the river near to Dunglass Castle, or higher up.

What is your opinion about the appointment of a Government Board to watch over and protect the interests of the navigable rivers of the kingdom?—I think a controlling power should be vested in some Government Board, particularly in regard to such rivers as the Clyde, where so much was at stake. The river would have been ruined in consequence of the great waste of money expended on law proceedings and jury trials, and purchases of water-side alveus, and mismanagement which had existed of late, if it had not been for the immense revenue derived, and increasing every year.

Who had the management of the river before the Clyde trust?—Previous to the year 1700, the town of Dumbarton, by an old grant or charter from the Crown, held the superiority of the river. It came into the hands of the corporation of Glasgow about 1700, and then by Act of Parliament in 1758; it was vested in that body as a public trust. At that time the depth of water on certain shallow parts, it has been stated, did not exceed three feet; where, as now, there was at Glasgow Bridge, 14 to 15 feet of water at neap tides, and 17 to 18 at spring tides.

Does that show great mismanagement?—He did not say there was great mismanagement in that respect; the depth, however, was very little increased till the commencement of the present century; and, by mismanagement, he meant the later acts of the trustees, and the waste of its revenues, and plunging the trust so much in debt.

Was it not in the river Clyde that steam dredging was first introduced?—He had heard so.

Do you know when steam dredging was introduced in the Clyde?—About the years 1820 or 1821.

There is some debt upon the trust?—Yes; an immense debt. First, there was borrowed money to the amount of 347,400*l.*; then there were feu duties, calculated at 25 years' purchase, representing a sum of upwards of 60,000*l.*, making, in all, the sum of 408,000*l.*, including the price of the Windmillcroft. There was to be added to that the price of Stobcross, and all other engagements not discharged, which he would assume at 100,000*l.*, making 500,000*l.*; and besides this, it was given out that the trustees were now negociating for other water-side grounds to the amount of 126,000*l.* additional. The revenue had fluctuated considerably since 1836. That year it was 45,000*l.* Subsequently it came up to 48,000*l.*, and then down to 42,000*l.* In 1836 the trust paid 6,000*l.* of interest upon 154,000*l.* of debt. Now, adding this to the sum of 14,000*l.* for the ordinary expenses of the trust, left out of the revenue a clear annual sum of 25,000*l.*, *which, in his opinion, if judiciously managed, was amply sufficient for all the improvements which were required. Now the revenue was absorbed by the immense amount of interest.*

Have you anything to say with respect to the present wharfs?—Portions of the walls had given way, but now they were founding them deeper; and I believe that everything is done which man can do, consistent with the means of the trust, to make the quays as substantial as possible. With regard to the walls which had been built within these ten years, and had already given way, he believed the foundations had been laid without contemplating that the dredging would be carried so far down. I think the trust should be placed under a controlling power to prevent them going to Parliament, and to prevent them from increasing their debt. Mr. Walker's evidence before the Committee of the House of Commons about the annual [increase of the revenue was all humbug. Witness did everything in his power to prevent the trust from getting power in the Act of 1840, to increase the amount of debt, but he did not interfere in the Act passed this year. He was of opinion that too little interest was taken in the merchants' sailing vessels; but he imputed no improper motives to the steam-boat proprietors, who were members of the trust, and always on the spot.

Mr. M'LELLAN explained that the trustees were elected without respect to any interest, special or particular.

Mr. BELL.—My idea is that the large vessels which required to lie a considerable time in the harbour should be sent into a basin to be provided for that purpose, and that the steam-boat interest should be accommodated from York-street up to Glasgow Bridge, and that the coasting craft should be sent above the bridge. In no other way could the shipping be brought so close together, and accommodated so economically.

Mr. JOHN ROBERTSON asked if the trade in the harbour could be more concentrated than at present; and if it could be better accommodated without lengthening the quays, and taking it down the river?

Mr. BELL.—Most certainly; by making a tidal basin at Windmillcroft for large foreign vessels taking a month to load. I am of opinion that, for foreign sailing vessels, Windmillcroft is not only the best, but the only place, and I would prefer it to any place on the north side that could now be got. The difficulty and expense would not hinder me from excavating that basin; and I am not afraid of its silting up. I am of opinion that the new quays on the north or south side of the river ought not to have been contracted for, but the basin excavated at Windmillcroft. If for no other purpose, I would begin the basin to-morrow to put the timber into it. For that alone, it would be invaluable, although they were not to put a wharf round it at all.

Mr. CHARLES GRAY.—In your opposition to the trustees, I believe you went so far as to go to the bank, and try to induce the manager not to advance any more money?

Mr. BELL.—The banker told me that he did not think the security of the trust sufficient to warrant him to do so.

Mr. GRAY.—I believe your statement very much confirmed his impression; at least you thought so.

Mr. BELL.—I was not then a member of committee, and I met the banker by chance, when it was by mere accident I was told that the trustees, or some of them, had changed their bank account to another banker, and this without acquainting the trustees generally; and I was certainly surprised that I, as a trustee, was not informed of such an important matter. The banker who acquainted me of the circumstance, stated that, on looking into the trustees' published accounts, the directors did not think so well of the account as to make it an object, considering the great amount of debt being contracted, and the other expenditure of the trust. There was one thing I did, however; I wrote to the Commissioners of Woods and Forests as a last resort, to save and reserve the rights of the Crown to

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 16th Oct., 1846.

MR. A. TURNER.

the alveus of the river. When I found the Clyde trustees going to pay 8,000*l.*, and other large sums, without getting the sanction of the Crown for that alveus, or warrandice in law from the sellers of the ground, I certainly did address a letter to the Commissioners as a loyal subject, to support the rights of the Crown, and, at the same time, the rights of the trust which were being sacrificed.

Mr. A. TURNER, examined.

He had been one of the secretaries of the trust since 1829, and, during the same period, one of the town clerks of the city of Glasgow. The first charter granted was that by Charles I., in favour of the magistrates and town council of Glasgow, in 1633 or 1660, he was not sure which, the date being partly illegible. That charter conferred the alveus of the Clyde upon these parties as a public trust. In 1770, the corporation was, by Act of Parliament, created a trust for the management of the river. Up to that time there had been scarcely any improvements made upon the navigation. Since 1770 there had been four subsequent Acts passed; and the Act 3 & 4 Victoria, cap. 118, as amended by the Municipal Reform Act, is that under which the trustees are now acting. The trust consists of 33 members, 23 of these being from the town council.

COMMISSIONER.—How many Bridge trustees?—All the members from the town council are Bridge trustees. It is not necessary that any members of the Board should be sailors or shipmasters. There is no qualification as to the residence of the trustees, but as counsellors they must be resident within seven miles of Glasgow. As Clyde trustees no qualification is insisted on, except that mentioned in one of the old Acts, to the effect that they should be interested in the Clyde, which is a very general qualification. Those different Acts empowered the Clyde trustees to borrow money. The last Act empowered the trust to borrow more money.

I see by the last Act a chart of the river was to have been made between Greenock and Glasgow?—It has been made. Soundings were made of the river previous to going to Parliament for a new Act. The present chart of the river was made some time after 1840.

Does the Act of 1840 compel the trustees to appoint a resident engineer?—Nothing compulsory; but it always has been the custom for the last twenty years to appoint one.

Has the trust received any complaints against the constitution of the Board?—Not since the passing of the last Act in 1840. Before the passing of that Act, the trust consisted of all the members of the town council, with five members nominated by them from amongst the mercantile body of the citizens. The number of the trust was then 36, and it is now 33.

For the management of this trust, is that number found to be too great or too small?—I don't think it is unmanageably large; and, looking at the duties to be performed, I think it is a very fair number. I do not think any twelve persons would have the confidence of the public; and that that number is too small. There is a Chamber of Commerce in Glasgow, the chairman of which is an *ex-officio* member of the trust.

Are regular minutes kept of the proceedings?—Yes. The trustees by their Act are obliged to meet once every month; and there are probably extraordinary meetings five or six times in the year. The proceedings of the committees are inserted in the minute-book. It is not directed to be received as evidence in the Act, but it is very frequently used as evidence.

Have you any difficulty in forming a quorum?—Very rarely since the new Act has come into operation. The average attendance at the meetings is about two-thirds of the total number of members. Nine form a quorum; and it has not occurred that fewer than that number were present above twice or thrice since 1840.

COMMISSIONER, having looked at the minute-book, asked if any statement of the revenue was laid before the trustees?

MR. TURNER.—Annually, but not at the monthly meetings. That statement is printed and published.

As far as a cursory inspection of the minute-book enables me to judge, it appears to be properly kept. Is there any separate minute-book for the proceedings of committees?—The Finance Committee have a separate book, which is in the possession of the treasurer. There are three standing committees,—the Finance Committee, the Committee on New Works, and the Committee on Existing Works; and in addition to these standing committees, other committees are appointed for special purposes.

Have the duties of the officers of the trust been defined?—The subject is at present under consideration, but the report of the committee has not yet been laid before a general meeting. The duties of the officers are already defined in the terms of their appointment, but in case they might not be sufficiently understood, it is intended to define them more explicitly.

My chief reason for making inquiries on this point is, that I remember having heard formerly that a member of the trust had directed a dyke to be pulled down or built up without the sanction of the trust. Was that not the case?—Something of the kind occurred when Mr. Bald was stopped in some operation by Mr. Spreull, who was one of the principal officers of the Board. The circumstance is fully explained in one of the minutes. Practically, it never does occur that the officers of the trust come into collision in the performance of their duties; and Mr. Spreull had no right as treasurer, to interfere with the executive of the trust. There is a clause in the Act providing that he shall not interfere. Both the treasurer and clerk are prohibited from holding any other office of trust or emolument under the trust excepting that of treasurer or clerk.

Generally speaking, have the clauses of the Act been complied with as respects the exhibition of tables of dues and bye-laws in the proper places?—In every way, so far as my knowledge goes.

Have you any remarks to make about Mr. Bell's evidence?—Had the questions been put to him *seriatim*, I could have shown that he was wrong in everything he said, and could have easily exposed his misstatements, but it is quite impossible to make a circumstantial answer to a speech two hours in length, and embracing all subjects under the sun. I have made some notes from the minutes on some matters referred to by Mr. Bell. First, in regard to the reasons for not constructing in the Windmillcroft a dock or basin; I find the minutes on the subject extend over a period of six months. The subject was fairly discussed at the Board, and on the 23rd of February, 1841, it was resolved by a large majority, that an increase of harbour accommodation was required as soon as possible; and that, as the proposed dock at Windmillcroft could not be completed and rendered available in a shorter period than four years, the extension of the quays should be proceeded with and the dock delayed, as, from the great expenditure which it would occasion, it was not desirable to proceed with both at the same time. The resident engineer made a report on the subject, which is inserted in the minutes at page 466, and that report tended a good deal to produce the resolution which the trustees came to. A plan of a wet dock was

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 16th Oct., 1846.

Mr. A. TURNER.

prepared by Mr. Bald. That plan was accompanied by certain borings made by that gentleman, but there is nothing in the minutes to show that the lands are unsuitable for a dock or basin. The trustees only agreed to do one thing before they did another; and Mr. Bremner reminds me of the very important fact, that provision was made in the quay wall recently erected at Windmillcroft to admit of an entrance being formed to the dock in the event of the trustees thinking it necessary to open up that dock. The question in regard to forming a dock or basin at Windmillcroft is still perfectly open. The subject, when before the trust, was only delayed for the present. The next point is in regard to Newshot Isle. The only minute which refers to it is at page 461 of the present volume, and it shows that this matter has not been lost sight of by the trustees. Mr. Bremner, the resident engineer, has been instructed to inspect the wall erected by Mr. Henderson at Erskine Ferry, and to report to the trust the effect which that wall has upon the interests of the navigation. The trustees have not considered the subject with the view of coming to any resolution in regard to it, as Mr. Bremner has not made his report, but when he makes his report they will do so. My impression is, that borings were made of the south channel at Newshot Isle by the engineer, Mr. Aird. The result of those borings should be now in the hands of the engineer.

The COMMISSIONER suggested, as it would not be attended with either much delay or expense, that new borings should be made, which would set the matter at rest; and Mr. M'Lellan said the trustees would have no objection to allow borings to be made.

In answer to further questions, Mr. TURNER said, Mr. Rennie, Mr. Telford, and Mr. Walker, all concurred in saying the north channel was the preferable one; and he considered it would be quite out of the question to go to Parliament to ask them to pass an Act to alter the navigable channel of a river sanctioned by such names. As a channel for the tide, Mr. Walker thought it should be kept open. Then the next point was, with regard to the weir and the contribution to be paid by the Clyde Trust, to get it removed higher up the river. The minutes at page 703 of volume vi., and at page 36 of volume vii., showed that the arrangement for removing the weir, and deepening the piers of the new Stockwell-street Bridge, to admit of the river being deepened between the bridges, to facilitate the upper navigation, had been gone into at the request of the Clyde Trust, and on the motion of Mr. Cogan, who was not a member of the Town Council, or of the Bridge Trust. The motion was seconded, likewise, by a member, who did not belong to either the Town Council or Bridge Trust, and was carried by a majority of 14 to 4 against an amendment proposed by Mr. M'Lellan.

Will you say how many members of the Town Council were present?—They were all members of the Town Council, except four and of these four, two voted for the motion, and two for the amendment.

Mr. M'LELLAN.—Fourteen of the eighteen were Bridge trustees.

Mr. TURNER said there was no use now in discussing the matter, as the arrangement had been deliberately passed and sanctioned by Parliament.

Mr. M'LELLAN said it involved a very serious responsibility, if, by that arrangement, the funds of the trust had been placed under submission to an unlimited extent.

Mr. TURNER said the submission referred to by Mr. M'Lellan was upon a totally different point; in fact, on a point of damages. The question at issue was, whether the Clyde trustees, by their deepening operations above Glasgow Bridge, had weakened the foundations of the Stockwell-street Bridge, and what was the amount of damage which had been sustained by these operations? The Commissioner must be aware that the Bridge trustees could claim that the amount of damage should be fixed by a jury, but to avoid expense, instead of having the matter settled by a jury, both parties had agreed to a submission, to Mr. Walker, and Mr. Smith, of Deanston, with Mr. David Aird for an umpire.

Mr. M'LELLAN asked who were the two parties in this case?

Mr. TURNER said the majority of the Bridge trustees did not think the matter should be settled in this way, but certain gentlemen in Ayrshire and Renfrewshire thought otherwise, and that section of the Bridge Trust are chiefly parties to the reference.

The COMMISSIONER asked if he was to understand that generally the Bridge trustees did not wish the Clyde Trust to pay them a large sum of money?

Mr. TURNER said they asked the value of the damage done to the bridge, and nothing more.

Mr. M'LELLAN asked if the Clyde trustees were prepared to pay a larger sum than 8,000*l*. to the Bridge Trust?

Mr. TURNER said the Clyde trustees had never given an opinion on the subject, but they wished the matter amicably adjusted.

Mr. M'LELLAN asked if Mr. Turner knew what the sum might be, and if it might be the double of 8000*l*.?

Mr. TURNER said the submission was in dependence, and probably it might.

Mr. M'LELLAN asked if the decision had not been given by Mr. Walker and Mr. Smith; he had been informed that such was the case?

Mr. TURNER said it was quite a mistake, and the question was exactly in this position: the Bridge trustees alleged that the operations of the Clyde trustees between the bridges had caused damage to the Stockwell-street Bridge, for which they claimed compensation; the Clyde trustees said no damage had been sustained, but agreed to refer the matter, and the arbiters had appointed the 16th of November to examine witnesses, and to fix the amount of compensation. As yet, no opinion had been given by the arbiters.

Mr. M'LELLAN asked whether or not those arbiters had given an opinion that the operations of the Clyde trustees had given rise to the necessity for rebuilding that structure?

Mr. TURNER said they had given no deliberate opinion on that subject. The question was perfectly open, and on the 16th of next month they intended to examine witnesses in regard to what injury the bridge had sustained.

Mr. M'LELLAN said he happened to be the chairman of a committee through which certain papers had to pass in regard to this matter, and he begged to state most positively that such was the present state of that submission, that the funds of the trust were perilled to the amount of 70,000*l*. or 80,000*l*. He stated this in the most solemn manner.

Mr. TURNER said there was no risk of that, as the whole estimates for rebuilding the bridge were little more than the half of that sum.

Baillie ANDERSON said it was quite impossible that Mr. M'Lellan's statement could be true, or that

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 16th Oct., 1846.

Mr. A. TURNER.

the funds of the trust were perilled to anything like the amount which he had stated, seeing that the estimates for rebuilding the bridge altogether amounted to only 41,000*l*.

Mr. **M'LELLAN** said his statement was founded on the information of Mr. Broom, one of the most respectable builders in Glasgow, whose son had given in estimates for the work, but since then they might have cut down the estimate by using cheaper materials in constructing the new bridge.

Mr. **TURNER** said Mr. M'Lellan might hear anything in the streets.

The **COMMISSIONER** said a point of great importance was, could the funds of the trust be implicated to anything like that amount?

Mr. **M'LELLAN**.—Let me put a plain question to Mr. Turner. If the Bridge trustees prove that the operations of the Clyde Trust have endangered the Stockwell-street Bridge, have the arbiters any choice but to give a decision against the Clyde Trust for the whole expense of rebuilding it?

Mr. **TURNER** said he could give an answer to Mr. M'Lellan's question, but he would only ask in return, if any one proposed that the Clyde trustees should act dishonestly? If it was shown satisfactorily that the operations of the Clyde trustees had made it necessary to take down that bridge, he thought it preposterous to ask if the Bridge Trust would not be entitled to damages.

COMMISSIONER.—Then it appears that the funds of the trust are liable to a great amount

Mr. **TURNER** said the whole matter amounted to this, that it was a question which required to be settled, and instead of being sent to a court of law, by a Parliamentary arrangement it was submitted to arbiters. The Clyde Trust possessed no power to destroy the property of others without being called upon to make compensation.

Mr. **M'LELLAN** said there was not a syllable in the Act of Parliament implicating the funds of the Clyde Navigation beyond a small sum, but this question of damage had been put in such a shape by the Bridge trustees, and by none more actively than the gentleman in the chair, as to endanger the funds, by having recourse to an ultra-parliamentary arrangement, a private arrangement, an illegal arrangement which he held would have a most injurious effect unless it were counteracted by the exertions of a few independent members of the Clyde Trust.

Mr. **TURNER** said Mr. M'Lellan, whatever might be his motives, was actually prejudicing the interests of the Clyde Trust by his statements.

Mr. **M'LELLAN** knew the contrary; his motives were pure and honest.

Baillie **ANDERSON** said the submission was approved of both by the Clyde trustees and the Bridge trustees when the matter was before Parliament, Mr. Gray acting on behalf of the former, and not being a Bridge trustee.

The **COMMISSIONER** asked if the Bridge trustees had any funds to rebuild the Bridge?

Baillie **ANDERSON** said they had the revenue arising from the frontages; and Mr. **GRAY** being referred to, stated that ample legal advice had been taken on the subject, their Parliamentary counsel having been consulted, and every caution manifested in regard to it.

The **COMMISSIONER** hoped the matter would be settled satisfactorily for the Clyde trustees.

Mr. **M'LELLAN** had protested against the funds of the trust being squandered in this way, and held the members individually responsible for any loss or damage which might result from the submission which had been illegally entered into.

The **COMMISSIONER** asked in what way protests were disposed of?

Mr. **GRAY** said they were regarded as a dead letter.

Mr. **M'LELLAN** said that Mr. Gray might find himself mistaken.

COMMISSIONER.—With respect to the 8th clause of 3rd and 4th Victoria, will you state whether or not a place of meeting had been provided for the Trust distinct from the Town Council, and a place in which the books and other documents might be kept.

Mr. **TURNER** said that provision of the Act had been complied with.

Mr. **BELL** asked if the books were never taken out at the trustees' own office?

Mr. **TURNER** said, as one of the town clerks, as well as one of the secretaries to the Clyde Trust, the minute-book was taken to his office; but the clause in the Act referred to the books of the Trust generally, and not to an officer holding a book connected with his own peculiar department. All the other books, plans, and even the greater portion of the title deeds, were here, excepting the sederunt books, which were properly in the hands of the clerk, writing the minutes. A letter book was kept, and all correspondence engrossed in it.

Mr. **BELL** asked if Mr. Turner had not corresponded with Messrs. Richardson and Connel, or Mr. Walker, in London, on matters connected with the Trust, and had not inserted those letters in the letter book?

The **COMMISSIONER** said, unless Mr. Bell could show that some evil had resulted from such a correspondence, he did not think it was of any consequence whether Mr. Turner had corresponded with these gentlemen or not.

Mr. **BELL** said he thought there was great evil in it, but it was only his opinion.

The **COMMISSIONER** asked if Mr. Bell could point to any particular letters?

Mr. **BELL** replied in the negative.

The **COMMISSIONER** having examined the minute and letter books, said, as far as he could judge, from a cursory inspection, they appeared to be correctly kept, and duly signed.

Mr. READMAN.

Mr. READMAN, *Treasurer to the Clyde Trust*, examined.

He stated that the books were kept by double entry; that he had a sufficient number of clerks to assist him; that he received the dues collected daily from the collector; that he paid all the accounts of the trust; that the auditor appointed to examine the accounts had the power to report upon, but not to disallow any charge; that if 1000*l*. were laid out for new works, not connected with the Clyde, the auditor had it in his power to report his opinion, which, coming before the general trust, and the press being present, became known to the public; that he kept a separate dredging book; that the dredging last year cost 8200*l*.; and that the balance was made up every year to the 30th of June, and the balance sheet printed.

The **COMMISSIONER** having examined the treasurer's books, said, so far as a cursory inspection could enable him to judge, the separate accounts appeared to be distinctly arranged and carefully kept; and they did great credit to the treasurer.

Mr. **READMAN** further stated that the collector brought the money collected every day to him, which he lodged in the bank; that he never kept any sum of money in his hands unless what was to be paid away the same day; that the collector gave security to the amount of 2000*l.*, and himself to the amount of 5000*l*; that he kept the ordinary annual expenditure separate from what was expended on new works; and that be paid all the wages, but that he had nothing to do with the taking on or dismissal of the men.

Mr. Corsar intimated that he had a plan of a railway to submit to the Commission, the chief object of which was to cross the river above all the bridges, and without touching the public green.

Commissioner.—Does this plan not interfere with the public offices?—The line passes at a distance of upwards of 60 yards from the court houses.

As a plan for crossing the Clyde, so far as I have seen, it is the most satisfactory. Will it accommodate the principal railways?—It takes up all the railways on the south side, and after crossing the river, keeps very much in the track of the Molendinar Burn till it reaches the Airdrie and Monklands Junction Railway Station on the College grounds.

Mr. G. W. Muir asked, in the event of the crossing indicated by Mr. Corsar being permitted, if it would prevent one from being made to the east of Stockwell-street Bridge.

Commissioner.—I cannot say; but I think a second will hardly be thought necessary, except for some very good reason.

Mr. Muir said he understood that Lord Auckland was willing to allow a railway to cross the river close to Stockwell-street Bridge. Indeed he had been informed that his Lordship had given a pledge to that effect.

Commissioner.—I am quite satisfied that no First Lord of the Admiralty would individually give such pledge; it is the whole Board of Admiralty who decide upon these matters.

Mr. Muir said this plan which he had the honour to produce was submitted to Captain Bethune, and special reference made to it in his Report.

Commissioner.—Captain Bethune's Report says that he would not recommend any crossing below Stockwell-street Bridge. [See Appendix, No. 346.]

Mr. Muir said his was not below Stockwell-street Bridge.

Commissioner.—Then it must stand open for consideration.

Mr. Muir complained that he and other parties had been taken by surprise from the short notice which they had had.

The Commissioner replied, that Mr. Muir must be aware that this was not a railway commission.

Mr. Muir said, seeing the whole of the parties interested in crossing the river were not prepared to lay their plans before the Commissioner, he wished to ask, if he would consider himself justified in reporting definitely on the subject?

The Commissioner said he had certainly not the least intention to report on that subject. The present Commission was only interested in the crossing of the river so far as it would affect the navigation, and with regard to the crossing of the river below the bridges, the evidence they had heard was amply sufficient on that point, and would be reported on accordingly.

Mr. Muir.—But no reasons were given.

The Commissioner said the engineer, both harbour-masters, and several of the Clyde trustees, had all given their opinions against such a crossing, and their opinions were, doubtless, founded on good reasons.

Mr. Muir said he cared nothing for opinions without reasons. He knew some persons who would like to see a railway bridge below the Glasgow Bridge, to prevent any attempt being afterwards made to open up that bridge; and his opinion was, that there would be much less harm done to the harbour by a railway bridge close to Jamaica-street Bridge than there would be from a railway bridge 110 yards below Stockwell-street Bridge. Not one yard of the large space of water above the old wooden bridge in process of removal could be rendered available for harbour purposes in consequence of that bridge, and the same thing would happen in regard to the space between the railway bridge and Stockwell-street Bridge, if the Caledonian scheme of crossing the river was to be carried into effect. The value and importance of that sheet of water might be gathered from the fact which was given in evidence yesterday, that the revenue derived from that portion of it between Glasgow Bridge and the wooden bridge was 4000*l.* per annum, with only quayage on one side. The Caledonian crossing was intended to be 50 feet wide, and the land stools would, therefore, occupy 100 feet quayage, besides being 100 yards below Stockwell Bridge on the one side and 90 on the other; and the trustees had agreed to sacrifice all that immense amount of space for a sum of not more than 8000*l.*, and not less than 4000*l.* In making that bargain, he believed that the Clyde trustees had sacrificed the interest of the trust. Some of the trustees even went up to London, and fought the battle of that company in favour of that bridge, and he believed received the pay of the Caledonian Company for their evidence.

Mr. M'Lellan asked if Mr. Muir alluded to him?

Mr. Muir said he did not, but that if he had been one of them he would have done so. The Commissioner had heard it stated that the Clyde trustees took up the railway Bills and disposed of them on their own merits; now, he submitted, that that was not the way to proceed, but that when many plans were proposed, they should have taken a comprehensive view of the whole, and decided in favour of that which would be most advantageous to the public. He considered that railway companies did a great public service, and that they were entitled to receive the support of Parliament when they applied for sanction to execute such works as were calculated to give increased facilities for communication throughout the country.

Commissioner.—Provided that they do not damage something else of greater importance; and in this subject I wish it to be understood, as my deliberate opinion, that the preservation and improvements of the Clyde Navigation and Harbour of Glasgow are of infinitely more importance to the real interests of the country than all the railways in Scotland.

Mr. Muir said the Clyde trustees knew perfectly well, for they had the plans before them, that the railway companies desired to form a junction; now what he blamed them for was this, that they went to Parliament in support of a scheme for crossing the river which would not effect the object contemplated by the railway companies. It was very easily to be seen that if the Caledonian Company had got their Bill, the Clyde trustees would still have been subjected to a repetition of the attempt to obtain permission from Parliament to cross the river in such a way as to form a junction between the railways on both sides. He submitted, therefore, that no bridge that would not give a junction to the railways, as well as a terminus, to the satisfaction of the principal railway companies, ought to be permitted to cross the river. He had been told that Lord Auckland had pledged himself to a bridge

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 16th Oct., 1846.

below Stockwell-street Bridge; now, what he wanted to know was, whether the Caledonian Company would be allowed to make a bridge there, if no other bridge were allowed to cross above that?

The COMMISSIONER said be thought Mr. Muir might rest satisfied that only one bridge would be permitted.

Mr. MUIR.—And that one sufficient for the requirements of all the railway companies?

COMMISSIONER.—I hope so.

Mr. MUIR said he wished the question settled, that parties might not be put to the expense in future of Parliamentary contests on this subject, and he hoped the Government would interfere till they had got all the plans and information before them, which would enable a competent Board to decide which scheme should be preferred.

The COMMISSIONER said he thought it would be better to reserve all the evidence regarding crossing the river which did not directly affect the navigation for the railway commission.

Mr. M'LELLAN asked if Mr. Muir represented any of the railway companies who proposed to cross the river.

Mr. MUIR said he was in favour of a crossing above Stockwell-street Bridge, but he was not in the pay of any railway company, and never got a penny from any railway company in connexion with this question in his life.

Mr. ANDERSON said Mr. Muir promoted the West of Scotland Junction Railway.

Mr. MUIR said the moment he knew of a better, he gave it up. He approved of the West of Scotland Junction scheme in preference to the Caledonian.

The COMMISSIONER said he thought there was no use in going further into this subject as he did not feel himself competent to report on the various schemes for crossing the river. The crossing above all the bridges would have his hearty support, for as he had said before, the preservation of the Clyde and the Harbour of Glasgow was in his opinion of far more importance than anything else.

(*Adjourned.*)

Wednesday, 21st October, 1846.

Evidence taken on the 21st Oct., 1846.

Provost MILLS.

The COMMISSIONER, in opening the proceedings to-day, said he found, on looking over his notes, that he had not got sufficient evidence to enable him to report satisfactorily with regard to this important river; and he had called this meeting, therefore, that other gentlemen might have an opportunity of giving the Commission the benefit of their experience on the subject.

WILLIAM MILLS, Esq., examined.

COMMISSIONER.—You were Lord Provost of the city of Glasgow at one period, and, in that capacity, chairman of the River Trust?—Three years, from 1834 to 1837.

In the course of those three years' experience, did it occur to you that the Board was the best adapted for managing this important river; did it appear to you that there were a sufficient number of mercantile men in the trust?—No; I did not think so at the time; but the Board has been changed very materially since that by the Act of 1840.

What, in your opinion, was the want in the constitution of the Board; and what would be an improvement in it?—I have had no experience under the present Act, but still I think the present constitution of the Board by no means the best which could be formed for the management of the river; on the contrary, I think it might be improved very materially.

Would you be kind enough to state what you think would improve it?—In the first place, I object to the present constitution of the Board because it is composed principally of members of the corporation, which is a yearly changing body. Although well enough qualified to manage the affairs of the corporation, the members of the town council, being liable to be changed frequently, it can scarcely be expected that they can acquire a competent knowledge of the affairs of the trust in the short period during which they may be in office. There is another reason: they are like all other men—they have prejudices and local feelings, and perhaps local interests, to serve, which should not belong to such an important Board of management.

At the same time, you are quite of opinion that the management of such an important trust should be committed to parties connected with the City?—I think it would be well to have a resident Board of the citizens to manage the affairs of the trust, with perhaps something like a controlling Board connected with and responsible to the Government. I look upon the Clyde as a national concern, and that there should be some responsible parties connected with Government to control its management.

Will you state whom the local Board should be composed of?—I have not taken that subject into consideration; and I wish it to be distinctly understood that I make no charge nor insinuation against the present managers.

I sent you a summons to attend here this morning, knowing you had been chairman of the Board; and, apart from all personal considerations, I wish to have your abstract opinion of what description of Board you think would be best for conducting the affairs of the Clyde?—It is very difficult to say without fully considering the matter; but I think the trust should be composed of gentlemen more connected with the shipping interest.

Do you think a Board composed of 33 members too numerous?—I have always found that a small committee manages matters better than a large one. The effect of having a very numerous Board likewise is to divide the responsibility too much; and I think upon the whole it would be better to have a less numerous Board. It is some years, however, since I ceased to be a trustee, and I am merely speaking in reference to the period when I was connected with the Board, and I never concealed my views at the time. I have not considered the subject sufficiently, however, to give a definite opinion in regard to it. My principal objections to the constitution of the trust are, because it is chiefly composed of members of the town council, who are liable to be changed every year.

By the new Municipal Act there is to be an alteration in the election of the town council, and the city of Glasgow is to be divided into sixteen municipal wards. Now do you think these wards might

APPENDIX C.
GLASGOW.
No. 317.
Evidence taken on the 21st Oct., 1846.
PROVOST MILLS.

be intrusted with the power to send members to the trust, electing them differently, of course, from the town council?—I think something like that number would be about enough to constitute the trust; but I really have not fully considered the matter.

Then we will leave that subject. During the time you were chairman of the trust, were there any complaints of the want of accommodation in the harbour?—Oh, yes; frequently. Steps were taken to obtain that accommodation; and an Act was obtained in 1840 specially for that purpose, which gave powers to extend the harbour and improve the river. I believe those powers have been acted upon to a considerable extent. That Act gave powers to open up the river above the Glasgow bridge, and that has been partially effected. It is desirable, in my opinion, that the improvements between the bridges should be carried out at once.

Did any complaints come before you as chairman of the trust in regard to the want of depth in the river and damage to the shipping in passing up and down?—Yes, that is another point of importance which should be attended to, the deepening of the river below the harbour.

I think you have stated, generally, that since you have been acquainted with the Clyde the increase of traffic has been enormous?—Very great, and there is no doubt but that it is still increasing; and I am satisfied that, even in spite of the railways, if the navigation is improved and the river deepened, so that large vessels may come up, the traffic of the river is likely to increase for a long time to come.

Is there any other point on which you can give us the benefit of your experience during the time you were chairman of the Board?—He answered generally, that he thought improving the river between the bridges preferable in the mean time to making docks. A number of American vessels came to his address, and he had asked the masters of these vessels in reference to dock accommodation, and they always preferred the river, seeing that the tide did not rise high enough to cause any inconvenience. It was during the time he was chairman that the Windmillcroft was obtained. It was obtained to make a dock. That had never been carried out; and he thought there was no necessity for carrying it out, but that they should prefer giving harbour accommodation in the river. He was not in favour of a dock at Stobcross until it was found that they could not get harbour room in the river.

With respect to the Board of Control which you have alluded to, are you of opinion that it would be generally beneficial to the interests of those connected with the trade of the Clyde that there should be a Government Board of Control over all the ports of the kingdom, or do you see any evil likely to arise from it?—I do not see any evil likely to arise from it, it it would not interfere with the management of our local affairs. There is no other point occurs to me on which I can afford the Commission any information.

Cross-examined by Mr. TURNER.—He never saw any complaints come before the trustees but which they showed the utmost desire to remedy. He approved of deepening the river and extending the harbour; and, supposing that were the course the trustees were now proceeding in, he would certainly approve of it. He would make docks at Stobcross after every other means of extending the harbour were exhausted, if no other place could be got.

Mr. GRAY asked how far Mr. Mills thought the quays should be carried down before the trustees proceeded to make any dock?—Mr. Mills said, as far as the Act gave them power.

Mr. GRAY said, as that was exactly what the trustees were doing, then he would think it expedient to make a dock?—Mr. Mills said, whenever a dock was necessary, he would think it expedient to make one; but he could not determine upon Stobcross or any other place.

Cross-examination resumed by Mr. TURNER.—Would you incur the expense of taking down the Glasgow bridge, and deepening the river between the bridges, so as to accommodate the largest class of vessels, to making a dock at Stobcross?—He would prefer exhausting the powers of the trustees in forming a harbour between the bridges.

I am now talking of accommodation for the highest class of ships—vessels of 600 or 700 tons, making it necessary to take down the bridge and deepen the river from 17 to 20 feet; and I ask, would you, from your experience and knowledge of the expense, prefer doing that to making a dock at Stobcross, near the end of Argyle-street?—If the trustees made the quayage between the bridges, of which there would be about 1500 feet on the north side, that would enable them to accommodate a great number of the smaller kinds of vessels, and give great ease to the lower harbour; and if that were done, it would be a good many years before they would require any more accommodation.

That is not the question; the trustees are already doing that. Do you think the trustees should open up the Glasgow bridge, and deepen upwards to the extent of 17 or 20 feet, in preference to making a dock at Stobcross?—He did not think that would be required if the space between the bridges was quayed and deepened, so as to admit of the smaller description of vessels. If the question was whether he would prefer to begin at once to take down the bridge and deepen between the bridges so as to let up the largest class of ships, or to make a dock at Stobcross, he was really not prepared to say which he would adopt. It was a very serious question; but rather than go to Stobcross he would make a dock, as originally intended, at Windmillcroft.

Suppose the dock at Windmillcroft would be of comparatively small extent, would you then prefer a small dock at Windmillcroft when you might have a large dock at Stobcross, which would accommodate the shipping for a long time to come?—He would answer that at once. When they found the space between the bridges and the Windmillcroft insufficient to accommodate the trade of the port, then he would go to Stobcross, if he could get no other more convenient place.

Supposing by the proposed Conservancy Bill it were provided that all new works should be sanctioned by a Board sitting in London before they could be executed; and farther, that an engineer should be appointed to advise this Board in London in regard to the works on the Clyde; and that there should also be a harbour-master not amenable to, or affected by, the resolutions of the trustees, would you, with your experience of the working of this trust, think—supposing all those powers conferred on a Board sitting in London—there would be no inconvenience felt by the citizens of Glasgow or the local Board in managing the affairs of the trust;—with a Bill of this kind before you, would you still think that a Government Board would be advisable, from the experience you have had?—Then I am to understand that it is a Bill to supersede the trust.

The COMMISSIONER suggested that Mr. Turner was putting a hypothetical case, as no question had been asked of Mr. Mills in respect to this Bill. Nor was it proposed by the Bill that the Board of Control should appoint a harbour-master, but, as distinctly stated in one of its clauses, call upon the local Board to do so.

Mr. TURNER said he would simply ask, then, if it were proposed to establish a Government Board,

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 21st Oct., 1846.

PROVOST MILLS.

having the control of their affairs and the power of preventing all new works which had not received its concurrence and sanction; and instead of being advised by a local engineer by a district engineer appointed by Government; with a harbour-master likewise not appointed nor removable by the trust, whether a Bill with these objects in view would meet with his approbation?—In reference to the present management of the river, he believed the trustees discharged their duties very ably; and he merely thought (and he had never concealed his sentiments at any time) that there ought to be a controlling power over the local Board in the management of this great trust. To have a Board, however, sitting in London to manage all the affairs of the Clyde would be very absurd; but to have a controlling power would be a very proper thing.

You approve of a controlling Board, separate and apart from local interests?—Yes.

What are to be the functions of the proposed Board?—He was expressing no opinion about any particular Board, but an opinion about things as they now exist, and he thought they might be improved.

MR. W. MUIR.

Mr. WILLIAM MUIR examined by the COMMISSIONER.

He was collector to the Clyde trust, and had been so since 1840. His duties were the collection of the whole rates, and the superintendence of the weighers on the quay. He had a certain number of men to carry out his directions, and these men were sufficient for the purpose. There were sixteen men upon the quays, and four clerks connected with his department. He handed the money collected to the treasurer every day. He gave security for his office to the trustees; and he was responsible for the clerks as respected money. He had the appointment of the clerks, subject to the approval of the trustees.

Are the dues levied to the full amount which the Act authorizes?—Yes; but vessels were only charged 2*d*. per ton, which he believed was the smallest amount charged at any port in the kingdom. The charge upon goods was 1*s*. 4*d*. per ton.

Do any complaints come before you on account of the pressure of the dues?—Individual cases, but not many. When any letters of complaint were received, he laid them before the Board, and acted according to their instructions.

Do the complaints ever take this turn—that the masters of vessels are unwilling to pay the dues on account of the want of accommodation?—There were often complaints of the want of accommodation, but the dues were always paid notwithstanding. He had no doubt but that, if the harbour were extended, the trade of the port would likewise extend. There was no other point connected with his accounts which he wished to call attention to.

The COMMISSIONER, after examining the collector's books, said, so far as a cursory inspection could enable him to judge, they were kept in very good order—in perfect order.

Mr. JAMES STEELE said the lighters plying between Greenock and Glasgow paid 2*d*. per ton, whereas the steamers paid only 1*d*. He complained that the lighters or sailing craft paid 2*d*., while the steamers paid only half that sum.

Mr. MUIR said it was according to Act of Parliament.

The COMMISSIONER asked if Mr. Steele was aware that these charges were according to the Act of Parliament?—Mr. STEELE said it was in the Act he was aware, having been altered in 1840; but he did think it very unfair that the dues on vessels plying between this and Greenock were the same as on vessels coming from the East and West Indies. It was not the same in any other port in the kingdom. They carried cotton from Greenock for 10*d*. a bale, and paid the trustees 5*d*. out of that.

The COMMISSIONER asked if he was afraid that the railways would take away the traffic if the dues were not modified?—Mr. Steele said he refused lately 1900 bales of cotton, which, had the dues been modified, he would have carried. He had mentioned this frequently to the trustees.

MR. M'CONNECHY.

Mr. M'CONNECHY examined.

He was local superintendent of works, and had been connected with the Clyde for eleven or twelve years. He received directions from the engineer as to the works he was to execute, and gave orders to the workmen under him.

You have been acquainted with the Clyde for twelve years, can you tell me what amount of deepening there has been in the river since that period?—There had been a great deal done towards deepening the river during that time, but he could not say exactly how much. Twelve years ago it would be about 13 feet at neap tides, now it was from 15 to 16 feet. In respect to removing boulders from the channel, very much had been done, but there were still some left. There was a bad point about eight miles down the river.

Do you hear many complaints of ships striking at this place on their way down?—Not now, but formerly.

With respect to the south channel at Newshot Isle, what is your opinion?—It was proposed to open up that channel, and part of the dyke was taken down, but that had been built up since. He had no official instructions on the subject, but he did it in repairing the dyke up and down the river. There were different complaints about small craft being driven upon the dyke, and about timber getting over it occasionally. The dyke was in good repair. It was about the height of high-water neap tide, but was covered at spring tides. He was very much up and down the river, and never saw many vessels lying aground. It was not the case that many vessels had lost their copper for some years past. If vessels kept the channel he did not think they should strike any place. There was a vessel came up yesterday, drawing 17 feet water, with a south-west wind. A north-east wind made a difference of two feet, but a north-easterly gale would not make a difference of five feet.

Have you ever known heavily-laden ships detained a long time in consequence of easterly winds?—Two or three days, and obliged to take out part of their cargoes. It was the practice for most of the ships to go away loaded from the quay, but some of them took in part of their cargoes lower down.

You have a diving-bell; what quantity of boulders can that bell lift in a week?—He had seen it take out 30 tons of whinstone-boulders in that period, with the assistance of the deepening machine connected with it. The stones which formed the dykes had a tendency to roll into the channel, until they obtained a slope of two to one. Rows of piles would have assisted the dykes in obtaining stability; but he could not say it would be an advantage now, from the difficulty of driving them. If it had been done at first it would have been an advantage. It was a very serious thing for a ship's bottom to get hold of a stone; but the deep channel was from 150 to 300 feet wide.

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 21st Oct., 1846.

Mr. M'CONNECHY.

Does it never occur that two steamers cannot pass?—Never, now, that he saw. He was going on deepening.

Have you any opinion respecting the tide coming up the south channel at Nushat Isle?—It was desirable, he thought, to keep up the dyke in the mean time for the safety of the small craft. If the dyke were pulled down entirely it would assist the flow of the tide. There would be a difficulty in deepening the south channel at Newshot Isle, because there was rock in it, besides those dykes which were built across the channel. Borings had been made, and it was solid rock. There was rock in that locality, Rashalie quarry being only about a quarter of a mile distant. His opinion was that that channel would be better kept shut up at present.

Supposing the south channel were opened up, would there be any disposition in the north channel to fill up?—He had not formed an opinion on that subject, and he did not think a larger body of water would go up the Cart. The borings of the south channel at Newshot Isle were made by Mr. Aird, and he could not speak particularly in regard to them.

Mr. TURNER said Mr. Aird made the borings in 1840, and was examined in the House of Lords on the subject when the trustees were in Parliament for their new Bill; and he was of opinion that rock was found in the channel, and not boulders.

The COMMISSIONER.—Is there a difficulty in making stone quays stand long in the Clyde from the nature of the foundations?—There had some of them given way lately; but he thought that keeping them up would not be an insurmountable task. He did not think the foundations so bad that timber quays were to be preferred to stone quays.

Have not the stone quays given way nearly the whole length of the harbour?—Yes; they had given way in a considerable number of places. Still he thought it better to have stone quays than timber ones: stone being easily got and cheap.

Have you anything further to say in regard to the river; did you ever examine the Stockwell-street bridge?—He examined the foundations some time ago, and they were in a very precarious condition; but it was supported a short time ago by two rows of piles. It was a good job. He did not think he could contrive any way to deepen the foundations of that bridge so as to keep it from being pulled down. The foundations stood too high.

The COMMISSIONER.—Might it not be secured by invert arches under it?—He did not think invert arches would secure it. The bridge was quite secure as it was at present, and would bear some little more deepening.

Mr. M'LELLAN said he wished to ask Mr. M'Connechy at whose sight the weir was placed at Stockwell-street bridge?—Sir John Macneill and Mr. Walker were the consulting engineers, and it was executed under the superintendence of Mr. James Thomson. It did not consist with his knowledge that those two engineers reported to the trust that the weir and piling had effected the security of the bridge. The original contract was 1050*l.*, but it cost more.

Mr. TURNER said the operations in question were not directed to making the bridge secure, but to keep up the head level of the river. The security of the bridge became an incidental question afterwards. The engineers did report it as secure when they had finished their work; but afterwards there were floods in the river, which altered their opinion. The floods caused deep excavations immediately below the Stockwell-street bridge; and the engineers had come to the opinion latterly that it was not secure, and they had reported to that effect to the bridge trustees.

Mr. M'LELLAN asked if the engineers had reported to the Clyde trust?—Mr. Turner said they had nothing to do with it.

Mr. M'LELLAN asked if they did not pay for securing the bridge?—Mr. Turner said they paid for removing the weir, and towards erecting it at Stockwell-street bridge. It would take a long time to get at the whole truth of the matter; and this was not the proper place for instituting such an inquiry.

Mr. M'LELLAN said he quite agreed with Mr. Turner that it would take a long time to get at the truth of the matter; but this weir, which he affirmed as a Clyde trustee on his own knowledge, was undertaken for the double purpose of securing the head level of the water and securing the stability of the bridge, was executed at the expense of the Clyde trustees, and at a cost of nearly 3000*l.* He would like to ask Mr. Turner why the two rows of piles which it had been agreed should be placed at Stockwell-street bridge had not been completed, and why certain Clyde trustees had interfered and given their sanction to the stopping of that operation?

Mr. TURNER said be would be very sorry to encroach upon the time of the Commissioner by any detailed answers on such irrelevant matters, but he was willing to put the whole of the papers referring to them into his hands. He could not say what portion of the piling was not carried out. The whole of the papers were in his possession at the present moment. No part of the piling was executed; and these papers would prove what he had stated.

Lieutenant WILLIAM FORREST, R.N., examined.

Lieut. FORREST, R.N.

Had resided in Glasgow about two years, and was a member of the Pilot Board. Although only two years resident in Glasgow, had been acquainted with the Clyde for a number of years, being connected with shipping coming up and down the river. The number of pilots was perhaps 50.

Is it found that is sufficient, or too many?—He thought the number was sufficient, but he did not think there were a sufficient number of efficient men. The practice of using tug steamers had done greatly away with the service of pilots; but the Board compelled every vessel to take a pilot. It was quite right that the pilots should be afforded the means of living, and pilotage was now compulsory. Pilots on the Clyde had not formerly been subjected to any examination, but they were now about to make them be so. The examiners were to consist of three professional members of the Pilot Board—Captain Pollock, Captain Henderson, and himself, who were all shipowners, and had commanded vessels. They had not had any meeting since the new system had been agreed upon; but it was proposed to revise the whole list, and only keep those who were efficient. The Glasgow Pilot Board had nothing to do with the pilots below Port Glasgow. The river pilots were not connected with any body but the Clyde trustees, and that Board had full powers to license them and to dismiss them. The members of the Pilot Board did not attend the meetings of the Clyde trustees. During the time

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on
the 21st Oct., 1846.

Lieut. FORREST,
R.N.

he had been acquainted with the Clyde he had heard few complaints of want of good pilotage, or of damage being done to the copper of vessels from a want of depth of water; not above one or two within the last two years. The river had not been particularly deepened during that period, and he had known vessels sail drawing 17 feet of water. The vessels going down were generally light, and they were more liable on that account to ground coming up than going down. He was not aware of the *Charlotte Harrison* having met with an accident in the river about two years ago. He was not aware that she struck the ground a little below Govan and got damaged, and he had not heard of it.

As you are in the habit of sailing up and down the river, what operations would you recommend for the improvement of the navigation?—He would recommend deepening and straightening the approach to the harbour, and removing the boulders from the bed of the river, which the trustees were now doing. He would spare no cost in clearing the bed of the river.

In your experience as a sailor, can you say if the character of a port depends upon the security with which vessels can get into harbour?—No doubt of it. Masters of vessels would not be so ready to bring their ships up the river if they were likely to receive damage.

Is it your opinion that—even providing additional quay accommodation should give way to deepening the river—deepening the river should be the first point?—That was decidedly his opinion. He was likewise in favour of enlarging the harbour as soon as possible, as accommodation was very much required.

Have you any opinion as to extending the accommodation between the bridges?—He was decidedly in favour of that space being made available for harbour purposes. If it were quayed and deepened, it might relieve the lower harbour of all the coasting trade. He would not carry out the proposed improvements so far as to open up Glasgow bridge, as he would prefer taking large foreign vessels into a dock lower down. The ground at Stobcross, he thought, was the only place suitable for a dock near Glasgow. The carriage of goods would be much more convenient there than from the south side. The distance was not above a mile from the principal cotton and other stores; and the cartage he thought would not be so heavy as to induce merchants to prefer the river. The custom-house was rather above Glasgow bridge, but it would soon be a great deal too small for the port. The trade should be brought as near the custom-house and the centre of business as possible.

You are decidedly in favour of a dock at Stubcross after deepening the harbour?—He would first deepen the upper harbour, and then he would make a dock at Stobcross. He did not think the Windmillcroft suitable for a dock. The place itself was too small in dimensions; and he thought it was necessary not only to provide accommodation for the present traffic, but to provide for an increase. He had not seen the plan for the mineral dock lower down the river. The rise of the tides was about eight feet. He would be contented with 17 feet of water in the dock. He did not think there would be great difficulty in managing the gates. There was no worm in this part of the river to injure the wood.

Can you afford any other information?—The securing of the wharfs was a great source of trouble; but part of the present walls might be saved if proper means were used. The filling in behind was the principal cause of the falling of the walls.

Have you ever considered whether timber walls would be preferable to those built of stone?—He would undoubtedly prefer timber walls. He had not been in Dublin lately, and had not seen the wooden quays at present being erected at that port; but, as a sailor, he thought timber walls by far the best.

Capt. BOYD.

Captain BOYD examined.

How long have you been acquainted with the Clyde, and what vessels have you sailed in?—He had been acquainted with the Clyde for 20 years, and for the last 13 years he had sailed with steamers of 200 to 1000 tons. He was at present commander of the *Admiral*, of about 1000 tons, which sailed between Glasgow and Liverpool. During the time he had been acquainted with the Clyde there had been great improvements made in it, but there was still room for further deepening and improvement.

Is there ever any difficulty in two large steamers passing each other in the river?—Between the Broomielaw and the saw-mill, about a mile below Govan, there was sometimes great difficulty in two large steamers passing. When they got up to the harbour they had plenty of room, as the berth was always clear for them. Their neighbours were sometimes jammed up, however; and there was a very great want of harbour accommodation.

What do you think the best mode of relieving the pressure?—The best plan would be to get some tidal basins made.

Whether would you prefer, a tidal basin or a dock?—He did not think they could sail from a dock and get down regularly to Greenock. Even although there were a tidal harbour or dock, the steamers would continue to use the quay. But he thought a tidal harbour would be of great service to the shipping. He preferred the north side to the south side; Stobcross rather than Windmillcroft; but the latter rather than the proposed dock at Govan. He approved of deepening above Glasgow bridge, for the purpose of accommodating a great deal of the timber and small craft. If accommodation were provided between the bridges, a great many of the coasting vessels from Ireland and the Highlands would go up to it. The large steamers were much annoyed with the rafts of wood coming up the river, by the great number of logs which were brought up together.

Are they not bound by law not to be above 30 feet wide?—He was not aware; but if they kept in the centre of the river they gave no room to the steamers. There was no doubt but that, for the convenience of the steamer-traffic, it was necessary to widen the river, and he thought that the first thing which should be done. He had been many times, from half a mile below Govan, an hour and a half and two hours in reaching the harbour. At half-tide there was no room to steer a large steamer, from the river being so narrow. The large steamers were of great value, and it would not be difficult to do a few hundred pounds of damage to one of them.

Have you ever any difficulty in getting away from your own part of the quay?—Sometimes he had a little difficulty. The large steamers were berthed at Anderston Quay.

Is not that immediately opposite where it is proposed to make the General Railway Terminus?—He thought it was lower down. The steamers were canted with a hawser on their arrival.

Have you known many accidents to arise from shipping going down the river scraping the bottom?—Ten or twelve years ago accidents of that description frequently happened, but not latterly. He had received some damage himself, but he never saw a ship across the dyke. He remembered seeing the *Mohawk* aground; but vessels often got aground on the side of the dyke by steering out of the channel. The *Admiral* carried a regular pilot; and from what he had seen of the river pilots, he supposed they understood their business. He would improve the navigation by cutting off the points of the banks. Passengers, when detained long in the river, grumbled very much. The straightening of the banks he thought should be done at once, as it would have a tendency to send the traffic to the railways, if not done. From the increase in the number of railways, there was no doubt but they might expect an increase of passengers and other traffic.

Is the approach to the river sufficiently buoyed and lighted?—There are two lights very much wanted—one on the north perch, and another above Bowling. He had never complained of the want of these lights, but had been thinking about handing in a letter.

Mr. TURNER said the principal owners of the vessel commanded by Captain Boyd were Clyde trustees; and Mr. M'Lellan added, that if the want of these lights had been represented to the trust, instructions would have been given at once to have them erected.

Captain BOYD, in reply to other questions, proceeded to say—the lights about the Cumbraes were sufficient. In sailing from Liverpool to the Clyde they kept too far to the west to make the light on Walney Island, but they always made the Douglas Light. It was the practice to sight that light in clear weather, but they never went within 15 miles of it. They always looked out for that light. The River Trust kept up all the lights as far as the Cumbraes, and the Commissioners of Northern Lights all beyond that.

Mr. TURNER said it was a distinct trust, which had the management of the lights under a separate Act of Parliament. The Lighthouse Commissioners consisted of a number of merchants connected with Greenock, Port Glasgow, and Glasgow. The Lord Provost and eldest Bailie were members, *ex-officio*, of that Board.

Captain BOYD, continued.—The *Admiral* drew 11 feet of water; and the removal of the bank at Port Glasgow by Mr. Bald was a great benefit to the shipping—one of the greatest benefits ever conferred upon vessels frequenting the Clyde. The channel, he thought, had continued to maintain its depth. Last winter he left the harbour about half-ebb tide, in a thick morning, and it was dead low water when he reached Greenock, still he got over the bank. He had known not more than four feet at low water on the bank, but he believed it was now never less than eleven. The banks were also removed by Mr. Bald at Garmoyle, and at the head of the long dyke, and these were undoubted improvements. At all these places they had gained at least six or seven feet of water since he had been in the habit of going up and down the river, twenty years ago.

Mr. JAMES STEELE examined.

Mr. JAMES STEELE.

You are connected with the Clyde Shipping Company?—He was manager to the Company, and had been connected with it for 28 years. During the time he had been acquainted with the Clyde he had noticed a very great improvement in its depth. The Clyde Shipping Company had a number of tugs. He received frequent complaints of accidents arising to vessels which he had towed up the river. These accidents occurred from collisions taking place between vessels going up and down, in consequence of the narrowness of the river and the want of depth.

Has that always been the case, even till lately?—Frequently. When the vessels were smelling the ground they lost their steerage way. He could not name any particular instance of damage at present, for fewer accidents happened now than formerly.

Is there a want of accommodation in the harbour; do complaints of that come before you?—The Company have four steamers for carrying goods, and nine lighters. All the lighters could go above the bridge, and they always went there when they could find berths. If the upper harbour were deepened and quayed, he would send all their lighters there.

You pay a large amount of dues?—They paid 2,600*l.* at present; and at one time they paid a sixth part of the whole revenue of the trust. The vessels of the Clyde Shipping Company had to wait their turn, and it was sometimes two or three days before they could get into a berth; but they had a prospect of getting two more berths soon. It was a great loss to the revenue of the trust, the want of harbour accommodation. They had to send many of their vessels to the canal to load coal; whereas, if they had got berthage at the quay, they would not have to do it. Last week be sent two vessels to the canal for no other reason. He had made this known to the trustees frequently. He agreed with Captain Boyd in thinking the points should be cut off the banks. In 1840, powers were taken to deepen and quay the upper harbour, which had only been done to a limited extent. He was clearly of opinion that great improvements had been carried out in the river; but he still thought that a Company, paying such a large sum annually as the Clyde Shipping Company, was entitled to get better accommodation. In 1830 they paid 3,200*l.*; 1831, 3,500*l.*; 1832, 3,200*l.*; 1833, 3,600*l.*; 1834, 3,900*l.*; 1835, 3,600*l.*; 1836, 3,700*l.*; 1837, 3,500*l.*; 1838, 3,500*l.*; and in 1839, 3,200*l.* After making a passage up from Greenock in three hours, they had sometimes to wait nearly six days for a berth. The Clyde Shipping Company were carriers only from Greenock. If they could get equal justice with the Liverpool and Belfast steamers, they could compete with and beat the railway in the carrying of goods.

Is there any other point?—He complained of the dues. The Clyde trust charged the same dues upon coasting vessels as upon foreign vessels. In every other port there was a differential charge on inland, coasting, and foreign.

When the schedule of rates was drawn up did you offer an opinion on the subject—was it discussed?—They willingly paid the does at that time; but when the opposition from the railway came into play, they found them to be very burdensome. The sailing vessels paid 2*d.* per ton on the hull, while the steamers, which did not go beyond the Cumbrae lighthouse, but sailed away north, paid only 1*d.* quay dues; and he thought both should be put on the same footing. Generally speaking, the dues upon the vessels were light; and even the dues on goods were light as compared to London and Liverpool. The Greenock charge upon the ship was very heavy, and upon the goods very light. The Greenock Harbour Trust charged dues for anchorage within four miles of the port. Although they did not go into the port at all they were obliged to pay.

Mr. GRAY said the payment of these anchorage-dues to the Greenock trust had been successfully resisted.

The COMMISSIONER.—You speak of having some additional quay room above Glasgow bridge; do you not think that whole space would be filled by the smaller craft if it were quayed and deepened up

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 21st Oct., 1846.

Mr. J. STEELE.

to Stockwell-street bridge?—Mr. STEELE.—He thought it would. It would not be necessary to lower the dues for berthage above the bridge to induce vessels to come up, they would willingly pay the same dues in the upper as in the lower harbour. There was no question but it would be advantageous to bring the trade of the harbour as much as possible into the heart of the city.

What would you think of a tidal basin at Stobcross?—He would like to see the upper harbour filled up before going there; and he thought it was the opinion of shipmasters generally, that a dock or basin at Stobcross would be attended with great inconvenience. They could send goods to Greenock almost as cheaply as they could cart them to Stobcross. The charge for cartage would be 1*s.* 6*d.* for a bale, and 2*s.* for a full cart. Cotton might be carried for 2*d.* or 3*d.* a bale. No doubt warehouses would spring up on the spot; but the brokers and shippers would like to have the ships berthed as near their own places of business as possible. He thought even Windmillcroft would be preferable to Stobcross; but although he was much in favour of improving the space between the bridges, he would not carry it so far as to make an opening in the Glasgow bridge.

Mr. T. BROWNLIE.

Mr. THOMAS BROWNLIE examined.

He was a contractor, and executed the weir at Stockwell-street bridge under the direction of Sir John Macneill and Mr. Walker. Two rows of piles were driven above, and two below the bridge.

Were your instructions to secure the bridge?—He got plans and specifications, and executed the work according to these. He did not think the bridge would tumble down; but something more would be required to be done to keep it secure. It would require a row of piles at the bottom of the weir. That was one which was left undone.

Why was it left undone?—He had no power over that. The whole cost was upwards of 3,000*l.*

Mr. M'LELLAN said he should like to ask Mr. Brownlie whether he considered that structure, with the works around it, were in a more or less secure condition than when the weir existed at the Glasgow bridge?

Mr BROWNLIE said he thought it was equally secure. It would require at present some pitching between the arches.

The COMMISSIONER.—You have had occasion to examine that bridge; now, as a tradesman, would you undertake to secure it?—He thought there would be some difficulty in that if the weir were removed.

Mr. M'LELLAN said he would like to know if Mr. Brownlie would undertake to execute an invert arch under the centre arch?

Mr. BROWNLIE said he thought it might be done, but he would not be very sanguine about it. The water at neap tides rose to the level of the weir.

Mr. TURNER said he hoped it was understood that, although the Clyde trustees could very easily do so, they were not called upon to answer all this irrelevant evidence. The works executed by Mr. Brownlie had nothing to do with the security of the bridge; and therefore, unless the Commissioner looked at the documents on the subject which he was ready to place in his hands he could form no correct opinion. Although, out of courtesy, a number of the trustees had attended the meetings of the Commission, the Commissioner must understand that their presence was not to be held as any acquiescence in what had been given in evidence.

Mr. M'LELLAN contradicted Mr. Turner's statements, and protested against the interference.

Mr. J. DREW.

Mr. JOHN DREW examined.

I am desirous of hearing whether you are of opinion that the weir ought to be removed, and the whole of the navigation opened up as far as it could be carried?—He thought so; and he thought that any obstruction to the tide should be removed. Quite apart from the bridge question, he thought it would be for the benefit of the river that the tide should be carried to the highest point. Were the upper navigation opened up, he thought small river steamers and lighters would go up for minerals. That had long been his opinion. He had been long connected with the harbour, and had had vessels running to it since 1811. Since then there had been very great improvements made in the Clyde. The navigation of the river had been very much facilitated since then, having been both deepened and widened. Last spring a vessel was brought up to him drawing 17½ feet of water; and he recollected when it was a wonder to the whole town when a vessel drawing 7 feet came up in the year 1798. The traffic in the river had increased in proportion to the improvements which had been made in the river and harbour. He recollected when the quay only extended to about 700 feet on the north side.

Mr. BREMNER said the quays now extended to 7,070 feet.

The COMMISSIONER.—And still there is a want of harbour accommodation?—Very great. The traffic had gone beyond the increased accommodation to a great extent. The farther up the shipping was brought the better. The shorter the distance the goods had to be conveyed between the warehouses and the vessels, the less likely were they to receive damage, and it was likewise more convenient for shippers to see their goods properly on board. He thought the deepening between the bridges would afford great relief to the present pressure. He was not aware that the merchants and shipowners had applied to the Clyde trust in regard to opening up the upper navigation. He was aware that powers were taken by the Act of 1840 to quay and deepen that space above the Glasgow bridge, and that it had been done to the extent of about one-third, or 550 feet.

Have you received complaints from any of your captains of the want of water in the lower part of the river, or of the ships striking boulders in the channel?—He had no vessels under his own charge, but he had known vessels frequently strike the bottom at North Bar. Recently, however, he had known ships sent down drawing 16½ feet of water, and although not able to float till it was high water, go down to the tail of the bank with one tide. He could not complain much of the ships in which he was interested being delayed when they came up to the harbour; and the harbour-masters did everything in their power to accommodate the trade. The opinion generally about the harbour-masters was, that they were very efficient public officers, and did their utmost to give all the accommodation in their power.

The COMMISSIONER.—I have no hesitation in saying myself, that at all the ports I have visited. I have not seen two more efficient harbour-masters than the two who have come before me in Glasgow. Have you anything farther to state with regard to the river?—He thought the river too much nar-

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APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 21st Oct., 1846.

MR. J. DREW.

rowed, and that the trustees should take advantage of some of the alveus for the purpose, where it was necessary, of widening the channel. Everything possible should be done to give a free flow to the tide. He thought that would be the means of saving dredging, the expense of which must be very great.

Is it the feeling of the merchants and shipowners here that they are sufficiently represented at the Board?—He had heard complaints frequently that there were not a greater number of gentlemen to represent the mercantile interests in the trust. He thought there should be a greater number of men at the Board interested in the trade of the port as exporters and importers, and who took an interest in the river. There was no evil in that Board being composed of members of the town council, farther than that he would think it better if there were more mercantile men and shippers amongst them. He thought the town council had a good deal to do otherwise; and he thought perhaps it would be better if the Board were to consist of a distinct body of gentlemen. He thought it must be evident that shipowners would take a greater interest in the improvement of the river than gentlemen who had not the same direct interest in its improvement. At the time of getting the different Acts of Parliament, nothing was done formally by the shipowners to get this altered, but it had often been mentioned. He acknowledged that the trustees had very much improved the river in depth; but in widening, they had still, he thought, a great deal to do. With regard to the quays, he thought they should be all made of timber. The stone quays were well enough, but they had given way in several parts of the harbour, and were kept up at immense expense and much inconvenience to the trade.

Cross-examined by Mr. TURNER.—All the trustees were indirectly interested in the trade of the port, and some of them directly interested. He merely stated that it was desirable that more of them should be shipowners and importers and exporters of goods.

Mr. TURNER asked if Mr. Drew would be surprised to learn that the members of the town council paid nearly the half of the whole rates and duties?

Mr. DREW said he was not aware of that; but he was aware that some of them were large steam-boat proprietors, and must pay a great deal of dues on that description of vessels.

Cross-examined by Bailie ANDERSON.—He did not know how many shipowners there were in the town council, or in the river trust. He knew Mr. Chapman was a large steam-boat proprietor, and must pay a large amount of river-dues. He knew a number of members of council who were not shipowners. All the councillors were men in business, but he did not know whether most of them were exporters and importers of goods or not.

By the COMMISSIONER.—He was in favour of encouraging the tide to flow upwards. If additional quay room were wanted and could not otherwise be got, he would make a tidal basin. Windmillcroft was a very good situation for a tidal basin if it could be made, but he understood the ground was not suitable. He thought it would be better there than farther down the river. The farther the trade was kept up the better, and more convenient for shippers. The stone dykes would be improved by having a better form, as they annually did a great deal of damage by tumbling into the river. Accidents were very common at one time, but not so recently. The Clyde trustees had very much improved the river.

Cross-examined by Mr. MUIR.—Had an opportunity been afforded by a preliminary inquiry being made before going to Parliament, a formal statement of their views might have been given in by the shipowners of this city to the trustees. He thought a preliminary inquiry, made on the spot by a responsible Government Board, might be of service when the trustees were about to execute any new works, and could do no harm.

Mr. M'GREGOR examined.

MR. M'GREGOR.

He had been a pilot, but never was licensed except as a deep-sea pilot. He had the charge of towing vessels up and down the Clyde, and had been between 30 and 40 years on the river. During that time great improvements had taken place. The size of ships which could come up the river 40 years ago, was from 50 to 60 tons; and the depth of water was something about 6 or 7 feet at spring tides. Now it was about 19 feet.

You have gone two feet beyond other witnesses on this point?—He had brought a vessel up the river himself drawing from 18 to 18½ feet of water at an extraordinary spring tide, and she did not touch the boulders. He had charge of a tug-steamer for towing ships up and down the river; and he was not aware of any vessels taking the ground, unless too late or too early on the tide. He was not aware of any copper being knocked off vessels coming up the Clyde of late. It was not within his own knowledge that several ships had within the last three or four years had their copper knocked off by coming in contact with the bottom of the channel.

Did you take the *Mohawk* down in 1843?—He had towed her down frequently. He did not recollect of her getting upon the dyke and having to go into dock at Greenock. He recollected something of the *Glenbervie* being damaged and having to go into dock in 1844. He had heard that the *Charlotte Harrison* was damaged in going down the river. He towed her down himself. If a few of the shoals were taken away it would improve the navigation. He remembered Port Glasgow bank being taken away, which was one of the greatest improvements ever made in the river. While the bank existed, it was only covered about 3½ feet at low water; now it was from 10 to 11 feet in depth at low water of spring tides. There was a gain of 7 feet in depth. The removal of the Garmoyle Bank was likewise a great improvement, which had been deepened about the same, 7 feet. The banks had likewise been removed at Dunglass, North Bar, and Finieston.

How many vessels do you tow up together?—From one to six or seven, according to their size; but he very seldom towed up more than one at a time. He found no more difficulty in towing up a ship in the Clyde than in any other river; and he would rather tow a vessel up the Clyde than the Thames. Not having so much traffic, they had fully as much room in the former as in the latter; and their draft of water in the Clyde was as good as in Woolwich Reach. The Clyde was one of the most harmless rivers in the world. It had no current to drive vessels either one way or another.

Do you ever come up by night. Is there a want of lights?—The navigation would still be the better with two more lights. He agreed with the evidence of Captain Boyd on that point. If there were a light on the north perch, and the one at Garmoyle were removed to the sand-bead on the north side, that would be an improvement. It was the duty of the Clyde trustees to place lights in the river above Port Glasgow. He did not think the pilots had ever made any representation about the want of

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 21st Oct., 1846.

Mr. W. BALD.

lights. There had been mistakes in consequence of the want of these lights. The only improvement which he had to suggest was, to make the river as straight as possible and to cut off the points. He had worked a vessel up the river, and had good help with the tide. Everything which would encourage the tide to flow up would be a benefit.

WILLIAM BALD, Esq., F.R.S.E., C.E., examined.

You were sometime resident engineer to the Clyde trust?—Yes; I was six years resident engineer on the Clyde.

Will you describe the state in which you found the river when you came to it; what were the chief obstructions to the navigation?—I have done that so fully already before the Tidal Board at the Admiralty, and it is reported so fully in the Appendix to the First Report, that I hardly think it would be necessary to go over it again in detail. The first great obstruction to the navigation which struck me in the river Clyde, was the Port Glasgow bank; the depth of water upon it varied a little from what had been stated by Captain Hugh M'Gregor and Captain John Boyd. The depth upon it at low water when I came to the Clyde, was from five to six feet; when I left it, the depth was from 10 feet 6 inches to 11 feet at low water, and at high water spring tides, the depth was 22 feet. A channel was cut through the bank about 700 yards long by 300 feet broad. From Captain Boyd's evidence, it appears that it more than maintains its depth, as he stated that he had last winter sailed the *Admiral* steamer, of 1000 tons, drawing 11 feet of water, through it at low tide time. The removal of this obstruction, by cutting a channel through it, was the key which opened the navigation of the river Clyde. The next shoal was the Garmoyle bank, upon which vessels frequently grounded. A channel was also cut through it to about the same width and depth as the one which had been cut through the Port Glasgow bank. I have heard ship-masters say, that the removal of these banks or shoals, by cutting channels through them, was a great boon to them, being a vast improvement to the navigation. The next bank which was removed was the shoal opposite Dumbarton Castle, and the one at the head of the long dyke.

What depth was gained on these banks, and what depth are they now?—The channels through these banks or shoals were cut to a depth of from 10 to 12 feet at low water, and the additional depth gained was from 4 to 6 feet. At Bowling there is a very considerable annual deposition, which requires to be constantly removed so as to keep the navigation open. I consider that the want of a river dyke on the left bank of the Clyde at that place is partly the cause of the deposition there. I also have to state, on reflection, that the shutting up of the south channel at the Newshot Isle, which was originally the main channel of the Clyde, had the effect of encouraging the deposition at Bowling; and if this ancient channel were opened up, it would greatly increase the tidal scour, and be the means of keeping the channel of the river clean. Lord Blantyre would not allow the river dyke to be put in opposite Bowling on the south side, although the trustees of the river were anxious that it should be done. I believe Mr. Walker had an interview with Lord Blantyre, who was the proprietor of the adjacent ground, on the subject, but his lordship resisted the proposed improvement of a parallel river dyke being made. I deny the power of any proprietor to interfere with the improvement of a tidal river, or its navigation in any manner. I do not think that the proposed dyke would do any injury to Lord Blantyre's property. It is most unreasonable that any landed proprietor should be allowed to assume a sovereignty over any navigable river so as to prevent works of improvement being constructed within and upon its water territory. The river Clyde is public property, and the public have a right to the full enjoyment of all kind of improvements which could be effected by those intrusted with its management under the Crown.

With respect to the Newshot Isle, you speak of the south channel as being the most direct and natural course of the river, may I inquire who caused the dyke to be built at the western end of it?—I always understood that the dyke built across the western entrance of the south channel, extending from Henderson's quay to the west end of Newshot Isle, was done by the orders and under the authority of the Clyde trustees. Since the south channel had been dyked up and closed, it had been filling up, and would shortly become green land unless opened. The dyke built across the west entrance of the south channel acted like a dam in retaining the river alluvium and causing a deposit. At the eastern entrance of the south channel, river dredgings had been thrown in by the superintendents acting under the trustees; this took place before I came to the Clyde. A beacon had been ordered by the Clyde trustees to be built on the left bank of the Clyde, immediately below the river Cart; but the conservators of the navigation of the Cart objected to its erection, and consequently it was not built; and about the same period of time the trustees of the Cart removed away all the old river dykes on the west side of the Cart, at its junction with the Clyde. The removal of those impediments was proper.

Do you remain of the same opinion, that it is desirable to open up that channel?—I have no hesitation in saying that the south channel, at the Newshot Isle, should be opened up. I have drawn up a paper containing my opinions on the subject, which I am willing to give to the Clyde trustees if they will print it. My object is to render the river every service in my power.

The COMMISSIONER said he would be very glad to get a copy of the paper. In the mean time, would it be more satisfactory to make it a reservoir or a through channel?—I shall furnish the Commissioner with a copy of the paper with the greatest pleasure. I would prefer making the south channel a through open channel, which would be better than making it a reservoir. I would open it completely up; it would be much more beneficial if left open for navigable and commercial purposes, and also for the tidal scour.

Are you clearly of opinion that if the south channel were opened the north channel would not silt up?—Yes; I have attentively considered the sectional areas and widths of the river Clyde below the Newshot Isle; in the narrow channel on its north side, also in the Clyde above it; the width of the rivers Black Cart, White Cart, and Gryfe; the length and extent of their reaches; the speed of the water in the Clyde above and below the Newshot Isle; and I have not the slightest apprehension that the opening of the south channel would inflict the least injury upon the northern channel by depositions of any kind. The objection which has been made to the opening up of the south channel of the Newshot Isle, or the main channel of the Clyde, is that the river cannot maintain two channels—that if the south channel be opened then the north channel will silt up, but no proofs have been given to support such an assertion; while the old maps of the Clyde, executed 46 years ago, exhibit two channels formed by nature—the northern channel at high water being at an average about 710 feet wide; while the south channel presents a remarkable configuration, being trumpet-mouthed, open-

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 21st Oct., 1846.

MR. W. BALD.

ing at its western, or seaward extremity, with a width of 800 feet, and at its eastern entrance, 530 feet—average width about 790 feet. The area of the southern channel is larger by about 6½ acres than the northern channel.

The width of the Clyde at high water, just above the Cart, by the old maps, is about 1020 feet; and the width of the Cart where it joins the Clyde is 650 feet, making a total width of 1670 feet: this is above the Newshot Isle. Now the mean width of the two channels of the Newshot Isle, added together, make 1500 feet; while the width of the Clyde below the Newshot Isle, and extending from its western end downwards to Erskine ferry, at a mean average exceeds 1000 feet, but the greatest width is 1500 feet.

Above Newshot Isle.

The descending velocity of the Clyde, between Glasgow harbour
and Newshot Isle, is . . . . 1576 yards per hour
The ascending velocity is . . . . 771 ,, ,,

Below Newshot Isle.

The descending velocity of the Clyde, between Newshot Isle and
Dumbarton Castle, is . . . . 2787 yards per hour
The ascending velocity is . . . . 1602 ,, ,,

These velocities show how the tidal waters are impeded in their ascent into the Clyde by the shutting up of the south channel at the Newshot Isle. The sectional area of the Clyde below the Newshot Isle is 7840 superficial feet at high water; and the sectional area of the Clyde, in the centre of the north channel of the Newshot Isle, is only 3920 superficial feet at high water. This shows that the south channel can be opened with great benefit to the tidal flow and the navigation. The opening up of the south channel would bring up the whole pressure of the tidal waters directly to the embouchure of the Cart with the Clyde; and instead of a movement of the tidal wave at a rate of only from six to eight miles an hour, as it is at present, from Bowling to Clyde Bank, it would move at a rate of more than from 10 to 14 miles an hour up to Clyde Bank.

From the facts here narrated, it is evident that the opening up and deepening of the south channel of the Newshot Isle, and clearing away other obstructions, would give such an acceleration to the tidal wave upwards into the Clyde, that there would be high water much earlier in the harbour of Glasgow than at present.

There would be a greater rise of the tides in the harbour of Glasgow. The tidal waters would ascend higher into the upper reaches of the Clyde, and also into those of the White Cart River, Black Cart River, and the Gryte River.

A greater quantity of tidal water would ascend up into the Clyde by having a wider, deeper, and a more direct channel at the Newshot Isle, consequently the ebbing scouring forces would be greatly augmented, to the benefit of the navigation.

This increased ebbing scour would eminently tend to the clearing away of all shoals or depositions which form in the river channel at Bowling, and lessen the expense of dredging.

The shutting up the south channel of the Newshot Isle, which was straight and direct in its course, and substituting, for the navigation, the northern channel, which is crooked, narrow, and circuitous in its course, have diminished the tidal flow and ebbing scour to a great extent, and have, I apprehend, tended to produce those banks and annual depositions at Bowling which have been, and still continue to be, a great and serious expense, besides an obstruction to the navigation.

After the removal of the shoal or bank at the head of the long dyke, one of the most important and necessary operations for the improvement of the navigation was the removal of the large stone boulders from off the rough ground lying between Erskine Ferry and the west end of the Newshot Isle, and clearing the ship channel through it. The rough ground extended for a distance of about 2000 yards along the bottom of the Clyde, and was the most difficult part of the river to dredge. Diving-bells and dredges were alternately employed. The speed of the engines was governed by the nature of the material at the bottom of the channel; and had to go slow when encumbered with heavy stoney matter, quicker when it consisted of soft, light material.

During the six years you were resident engineer are you aware of any vessels taking the ground?—I have of my own knowledge known vessels having frequently grounded on the rough ground; and I am certain, when heavily loaded, that they must have been strained and injured to some extent. The men working in the diving-bells frequently found pieces of copper and iron which had been torn away from the bottom of ships, and this was an indication that serious injury had been done. A ship heavily loaded, and grounding on a bottom covered with boulder-stones, was very different from grounding on soft sands. The navigable channel through the rough ground should be made deeper and wider than any other part of the river, so that no vessel, either outward or inward bound, should run any risk of grounding on so dangerous a bottom; and the trustees should particularly direct their attention to the improvement of this part of the navigation of the Clyde. A ship loaded and bound for a foreign port, in being towed down the Clyde, should she even touch the bottom at the rough ground, the copper would be injured, the wood exposed, and the consequences might be, that the *teredo navalis* might pierce the bottom and the ship be lost out in the deep sea.

Another improvement was made at Spiers Hedge, about 4½ miles below Glasgow harbour. Ships frequently grounded there. The bottom consisted of boulders and stones of various sizes. Some of the stone boulders lifted by the diving-bells were grooved or worn away on the top by the keels of vessels rubbing over them. These stone boulders are lying on the brink of the river, south side, where they had been deposited, after having been taken up by the diving-bells from the bottom of the channel of the river.

The next improvement was cutting away the point of land at White Inch, on the right bank of the Clyde, which was about 800 yards long, and contained about four acres of ground. This improvement was commenced by the late Mr. Logan; but the river dyke and cutting were terminated under my direction. The river at this part is 410 feet wide.

The point at Govan, two miles below Glasgow bridge, was cut away, or rather, it is more correct to say, that a great part of it above low water was allowed to be washed away by the river, the waterside dyke having fallen. This point was 250 yards long. The Clyde at Govan was only formerly 170 feet wide, it is now more than 300 feet wide. The old ferry slip and quay wall were removed and new ones built, so as to give the necessary channel breadth, this was a great improvement to the navigation, being so close to the barbour of Glasgow.

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 21st Oct., 1846.

MR. W. BALD.

Plans were drawn for cutting off the point at the lands of Overnewton. A considerable cutting and widening were made on the lands of Lancefield; and a new quay-wall was built, 560 feet long, executed under my direction, agreeably to the plans, sections, and specification drawn out by me.

The outer arms of Mr. Napier's dock were removed away, and the passage through the harbour considerably widened and improved.

A very considerable cutting was done on the south side of the harbour, extending from the west end of the Windmillcroft to the Kinninghouse Burn, and a whinstone dyke built along the part cut away; this was a great relief, in giving additional width to the lower part of the harbour. The steam-boat wharfs near the Jamaica-street bridge were executed under my direction, and agreeably to the plans drawn out and designed by me. Since my appointment in 1839, there have been finished in the harbour of Glasgow, 1120 linear feet of stone quay-walls; of stone breast quay-walls, 166 linear feet; of new sheds, 1647 linear feet; with gas-pipes, lamps, &c. There have been laid down on the south side of the harbour, 750 linear yards of 6-inch main-pipes; 604 linear yards of 3-inch branch pipes, with fire-plugs, stop-cocks, and wells; and on the north side of the harbour there have been laid down 1233 linear yards of 6-inch main-pipes, &c. At Lancefield new quay there have been laid down 320 yards of water-pipes, &c. A new dredge-boat, capable of working in from 17 to 19 feet depth of water, with an engine of 22-horse power, constructed for her under my direction. A new tug steam-boat, with two engines, each 30-horse power. Machinery has been fitted up on board of each of the steam-dredges in 1842, to move them forward by the power of the engines instead of manual labour, and which has been a considerable saving to the trust. A new ferry stone quay-wall and slip, 170 feet long, have been finished at Govan ferry.

What has been done in regard to improving the upper navigation?—A wooden wharf, to the extent of about 500 feet, has been erected on the north side above Glasgow bridge, and that part of the upper harbour has been deepened. The piling was put down to suit a depth of two feet at low water, being the depth required by the Act of 1840; if more depth be required, it would be necessary to re-pile to a greater depth, and also to secure the present timber breast. Nothing was done above the old wooden accommodation-bridge. I was directed by the bridge trustees, in 1841, to examine Stockwell bridge, and to report upon its condition.

Was the bridge tolerably secure then?—At that time it was strong enough to stand for ages; but I did not take into consideration any operation at that time in connexion with it, such as the removal of the weir. Below Stockwell bridge there were then pools of 16 and 17 feet in depth, and I suggested that they should be filled up with road-metal to the then low-water line. I had nothing to do with the construction of the weir at Stockwell bridge.

In the course of your examination of that bridge you found it secure?—Perfectly secure for ages to come, as stated in my Report, and printed in the *Glasgow Herald*, April 5th, 1841.

Now suppose that the upper harbour were deepened, could the bridge be secured without pulling it down?—I have built many bridges, and I am of opinion, that if the space between the Stockwell bridge and Hutcheson's bridge were required to be deepened, but which the Clyde trustees have no powers at present to do, invert arches might be built, so as to render Stockwell bridge perfectly secure, and give from six to seven feet depth of water at high tide through it.

It would be attended with considerable expense?—I could not say exactly, off hand; but I think it might be done for 6000*l*. I have not submitted to calculation what a work of that kind would cost, but decidedly it would not amount to 10,000*l*. This would admit of a considerable flow of the tide; and the small craft might then be taken above Stockwell-street bridge, and the timber to the City wharf at Hutcheson's bridge, which is now quite unavailable, and is at present railed in.

How far is the tide carried up?—About 700 yards above the Glasgow water-works, or about 3½ miles above Glasgow bridge. The removal of the weir at Stockwell bridge would be useful for the purpose of small shipping craft ascending the river, as well as for the tidal scour. Coal comes down the river at present to near Hutcheson's bridge.

Is it not the length of the column of tide that does the good in scouring away shoals and improving a river?—When the influx of the tide is diminished, the tidal scour is also diminished. The speed or velocity of the ascending and descending waters is necessary to the navigation; and the increased influx of the water acts beneficially for the purpose of the general scour of the channel throughout the whole reaches of the river, acting both by its weight and pressure, also by its momentum or force. If every obstacle were removed, the south channel at Newshot Isle opened up, and the long dyke at Dunglass removed more towards the left bank of the river, there would be high water earlier, and a greater rise of tide in the harbour than at present. The proof is, that the rise and fall of the tide are greater at Port Glasgow than at Garmoyle and Bowling. The rise and fall of the tide lessen as you go up the Clyde.

Is that owing to the incline in the bed of the river?—It is not in consequence of that, but to the obstruction which the volume of tidal water meets with in ascending the Clyde.

			Feet	Ins.
In the harbour of Glasgow the tide rises in springs			8	4
At Clyde bank	,,	,,	8	0
At Bowling	,,	,,	8	9
At Port Glasgow	,,	,,	10	5

If the river Clyde were sufficiently deepened and widened, and all obstacles or impediments to the free and full influx of the tidal waters removed, there might be nearly the same rise and fall of tide at Rutherglen as at Port Glasgow, or within 14 inches of it.

I should like to hear your opinion on the present state of the quays. Have the stone quays given way much?—Very much. The stone quay-walls in the harbour of Glasgow were never laid sufficiently deep, nor were they strongly enough piled in the foundations. Some of the quay-walls were puddled behind with a strong retentive clay puddle, which prevented the water being discharged from behind from the land springs, consequently the pressure of the back water pushed the quay-walls forward into the harbour. In other cases in deepening the harbour, the piles in the foundation have been sometimes laid bare to a depth of three and four feet, through which the tidal waters and the land springs flowed, carrying away all the sand and other fine matter from under the foundation of the masonry; the consequence has been, that the quays have in many cases sunk down and bulged outwards. The quay-walls have been built 20 feet high; and the harbour-master, in working the large ships in the harbour, requires to have a depth of 24 feet, by spooning out the deposit lying along the

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 21st Oct., 1846.

MR. W. BALD.

front of the piles in the foundation. Apertures have been left in the new quays lately built at low-water line, to permit the back waters to pass freely through them into the harbour; and all behind the quays have been packed and filled with open rubble-stone, hand laid.

From your experience, would you think it advisable to extend the stone quays?—I would most decidedly recommend timber, which, as there is no worm in the harbour of Glasgow to injure it, is, in my opinion, to be preferred; but where the worm exists, it perforates and destroys it in a few years. Wooden wharfs are quickly erected, easily repaired, constructed at less than half the expense of stone, and there is no danger of their coming down. The steam-boat timber wharfs have answered extremely well.

How long do you think timber wharfs would stand?—If constructed of red pine and pitch pine, they would last, with care and attention, from 20 to 30 years. There would be no inconvenience in replacing them. Stone quays, if laid deep enough and properly founded, would stand longer; and they might be built without much piling, by substituting concrete or beton for a foundation. The replacing of timber wharfs would cause far less inconvenience to the shipping than the rebuilding of stone wharfs. I am acquainted with Belfast and Dublin, and have seen the timber wharfs at those places, and think it would be an advantage to have all the quays in the harbour of Glasgow made of wood.

Is there any other point on which you can give us the benefit of your experience?—I have nothing further to mention but this, that there are two docks proposed to be constructed at Stobcross, but I do not approve of them. I would prefer a tidal harbour with a wide entrance, so that large ships and steamers could at all times go easily in and out. But my opinion is, before any docks be constructed at Stobcross, that the upper and lower harbours of Glasgow, along with the tidal basin in the Windmillcroft should be first finished and completed.

What is the rate of silting in Glasgow harbour?—It is very considerable. There are two kinds of silting in Glasgow harbour, one from the sewerage of the city, and the other from the deposition which comes down the river during land floods and freshes. I once proposed a plan for getting rid of the sewerage, by running a large sewer parallel with the river from above Hutcheson's bridge down to below Stobcross, into which all the common sewers of the city on the north would be emptied, and the contents carried down below the harbour. Although I have spoken to some of the river trustees on the subject, nothing has been done to carry it into execution. The deposition in the harbour is greatest below Glasgow bridge, and gradually diminishes downwards to the entrance of the harbour below. The removal of the deposition in the harbour is attended with a large annual expense. If the tide were permitted to flow four miles up above the harbour, it would tend, by the downward scour, to lessen the deposition in it, and, consequently, the annual expense; but dredging, in my opinion, to keep it clear, would still be required. There was an error originally committed in the formation of the harbour of Glasgow; had it not been made so wide, the river, by the descending scour, might have been able to have maintained its depth without any deposition, and tidal basins might have been constructed on both sides of the river for the accommodation of the shipping. Those tidal basins would have given perfect security to the shipping in time of ice-floods, and the river kept clear for the shipping to pass up and down.

The Clyde trustees had given great consideration to the subject of carrying into effect the parliamentary plan of 1840 for widening the river Clyde; and they found that it would involve so great an expense, and so long a period of time to accomplish it, that in 1841 I was directed by them to give in a plan of the width to which I would recommend the river Clyde should be enlarged, and which was as follows:—

300 feet wide at the mouth of the harbour.
310 ,, at the Kelvin river.
312 ,, at White Inch.
322 ,, at Renfrew.
400 ,, at the mouth of the Cart, &c., &c.

Mr. Walker's lines at the mouth of the Cart were 475 feet wide. I am clearly of opinion that an average width of 350 feet from Glasgow harbour to the river Cart is quite sufficient for any trade which Glasgow may ever have, exclusive of the slopes of the banks. I think the best slopes for the river-dykes in the Upper Clyde would be two of base to one of height. I would re-model and re-construct the whole of the entrance-works in the Lower Clyde, and also the greater part of the river-dykes. The whole of the dyke, extending from Dunglass to Dumbarton, should be set more to the southward or left bank of the river, and so constructed as to invite and lead up the tidal flux without the least impediment. More than a mile of the dyke would require to be altered. It would cost some expense. I have in general been in favour of half-tide dykes with beacons in the lower Clyde, and dykes to full tide in the upper Clyde. The former to direct the current and give no obstruction to the tidal flow, and the latter to prevent the river banks from being washed away.

Mr. M'LELLAN.—Perhaps you can inform the Commission whether the weir was completed at Stockwell bridge before it was removed from the Glasgow bridge?—I think it was nearly completed.

COMMISSIONER.—Has any damage been done to Stockwell bridge by the operations of the Clyde trustees?—No. I examined the bridge yesterday, and it did not appear to me to have sustained any damage. There is a small part of one of the pier-aprons, under one of the arches, which the bridge trustees should have repaired last summer, and which appears to have been neglected. To make the bridge still more secure, I would recommend a row of sheeting-piles to be driven down at the west or lower side of the weir, and to fill up all the deep pools or holes immediately below it in the channel with rubble-stone. I have not lately sounded the depth of water in the river at Stockwell bridge.

Looking at the state of that structure—looking at the nature of the foundations of the piers, do you consider there is any engineering difficulty in the way of the powers of the Clyde trustees being carried into effect at present. Do you consider that the operations may be safely proceeded with in the upper harbour?—Yes; I think the operations can be safely proceeded with in deepening the upper harbour to two feet below low-water line, as specified in the Act of 1840, and without in the least endangering Stockwell bridge. I was of the same opinion as Mr. Walker, that the bridge could be so secured.

Did he say so?—Yes; he put into his parliamentary estimate of 1840 a sum of 600*l.* for that purpose, and to preserve the summer level of the Clyde at Stockwell bridge. Under Mr. Walker's direction a sum of 3200*l.* has been laid out to attain those objects—in securing the bridge and constructing a weir to maintain the summer level of the Clyde.

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 21st Oct., 1846.

Mr. W. BALD.

You are aware that the present powers of the Clyde trustees only extend to the west side of Stockwell bridge; but supposing that the public interest should require the upper navigation to be opened up, do you see any engineering difficulty in the way of throwing an invert arch under Stockwell bridge, so as to give at least from four to six feet additional water beyond what it is at present?—I have already stated that it was my opinion that a depth of six or seven feet might be given at high water at a cost of less than 10,000*l*., and Stockwell bridge secured.

Mr. MUIR.—In your opinion would it be much better to improve the harbour between the bridges than to make a dock at Stobcross, in point of convenience and accommodation?—There is no doubt of it. I do not think that the inconvenience of opening Glasgow bridge for some time each night would be very great to the inhabitants of the city, or dangerous to property. The bridge would require to be taken down and a drawbridge formed in the centre. It would be only opened during the night tides, when no traffic was going over it. I have repeatedly gone over the Glasgow bridge at three o'clock in the morning and met with no traffic, and even scarcely with a foot-passenger. When I first came to Glasgow I was struck with the capabilities of that large sheet of water between the bridges for harbour purposes. It would accommodate 144 large square-rigged vessels near the centre of the city; and there was nothing to pay for the water-space or ground. I consider that two iron bridges, one at Jamaica-street and one at Stockwell-street, would at the least cost about 70,000*l*. I am aware that the ferry-boats are stopped at nine o'clock at night, thus showing that there was no such extraordinary occasion for keeping Glasgow bridge entire for the accommodation of the public. I do not think there would be any danger whatever to the banks by deepening the river between the bridges. The house property along the banks would not be injured in the least, as quays would be formed on both sides. All the timber should be taken to above Hutcheson's bridge, the small craft between that and Stockwell bridge, and large vessels between Stockwell and Glasgow bridges, but higher up if possible. Between the bridges was the most valuable space for harbour purposes to be anywhere found about Glasgow.

COMMISSIONER.—Before you leave, Mr. Bald, I wish to ask one question not exactly connected with the Clyde. It fell to my lot to travel, by the coast road, round the north-eastern coast of Ireland last year, where I saw many tunnels through rock, and bridges—were those of your construction?—They were.

COMMISSIONER.—The road I refer to is one of the finest works of the kind in Ireland, and does great credit to its designer. And it would be doing injustice to Mr. Bald did I not add, that I consider the suggestions he has made for the improvement of the Clyde and harbour of Glasgow are of a most valuable description; and I have little doubt but that, sooner or later, it will be found to the interest of all parties that most of them should be carried into execution.

Mr. GALBRAITH.—Do you consider that a tidal basin formed at Govan would be of any advantage to the harbour?

Mr. BALD.—A basin for mineral traffic down near Govan, it was his decided opinion, would be useful both for relieving the harbour of vessels loading with coal, and for adding to the scouring power of the tide by the reflux of the accumulated water.

Mr. M'LELLAN asked if widening the river to 400 feet would very much increase the tidal waters above Glasgow bridge?

Mr. BALD said, no doubt of it; but it would take 45 years, and the combined operation of five steam-dredges, to give a uniform width of 400 feet.

Mr. C. GRAY.

Mr. CHARLES GRAY said, with the permission of the Commissioner, he had a few observations to make with regard to the constitution of the trust. He had given the matter a good deal of attention, and his opinion was, that the number of the trustees was considerably too large, and that the election was too much of an annual one, all the members, in fact, with the exception of the *ex-officio* trustees, being annually appointed: that from the number of new members returned at some elections, the business of the trust, for some time after an election, and perhaps for some time before it, was somewhat impeded. He thought there should be no *ex-officio* members in the trust with the exception of the Lord Provost; that neither the Bailies, the Chairman of the Chamber of Commerce, the Dean of Guild, nor the Deacon Convener, should be members, *ex-officio*. Those gentlemen were appointed to their respective offices from other considerations than their fitness for discharging the duties which devolved upon the members of that trust. The constitution which he would beg leave to suggest was, that the Lord Provost should be chairman of the trust; that six members should be appointed by the Town Council, two members by the Merchants'-house; and one by the Trades'-house, without any restriction as to the individuals to be chosen; and that the appointment of three members should be vested in the Government, or the Lord Advocate: making in all 13. Farther, he would propose that as near as possible a third of the trust should go out annually. He likewise thought there was a great want at present felt of a head manager. This was the cause of throwing an immense labour on the members of the trust; so much so that it would soon be difficult to get men, properly qualified, to undertake to perform the duties. In the mean time he thought the affairs of the trust were generally as well managed as they could well be under the present system; and he thought the representations of parties connected with the river were attended to as far as they possibly could be with a proper regard to the extent of the funds at the disposal of the Trustees.

Mr. MUIR suggested that none of the members of the Clyde trust should be bridge trustees.

Mr. GRAY said he would leave it to the town council, as quite competent to judge, to choose what members they might think proper. He might mention, that last year the number of standing committees was increased from two to three; but he did not think this change had been attended with any advantage, and he did not think it had diminished the labour of the members. In respect to the interference of Government, except that interference were carried too far, he thought it extremely desirable to have some properly qualified person to take the supervision of the tidal harbours in this country. Perhaps one person might not be able to attend to all the tidal harbours in Scotland; and in that case, one might be appointed for a certain district, whose duties should be to examine into the management generally of the various local boards and trusts, and to report to a Government Board, or the Admiralty, his opinions in regard to what came under his cognizance. Such an officer might be useful in preventing encroachments upon the rights of the public in connexion with their navigable rivers, and in protecting the various trusts from being dragged into parliamentary contests by railway companies or other parties, by which the public money was needlessly expended. It would be recollected that the Clyde trust lately spent a large sum in opposing a Bill promoted by the Greenock Harbour trust; and the Greenock trust also spent a considerable sum in opposing the Clyde trust Bill of 1840. In respect to

APPENDIX C.

GLASGOW.

No. 317.
Evidence taken on the 21st Oct., 1846.

MR. C. GRAY.

the Bridge trust, he thought many advantages would result from the bridges being placed under the same management as the river and harbour. If the two trusts were conjoined, of course the expense of management would be much less than it is at present.

The COMMISSIONER said, with respect to the Government Bill, it never was intended to interfere with the local officers, or to take any of the management out of the hands of the local Boards, as long as those Boards did their duty as required of them by their respective Acts of Parliament; and, unless he was greatly mistaken, the 7th clause of the Bill expressly stated this.

Mr. GRAY said it seemed, from some of the clauses, that the local Boards were to be entirely superseded, or nearly so.

The COMMISSIONER said he was of opinion there had been some mistake in the reading of the Bill; but those who had a knowledge of the subject had only to offer such valuable suggestions as Mr. Gray had done, and he was sure the Commissioners would be happy to attend to them, and to give them their fullest consideration.

Mr. M'LELLAN said he thought Mr. Gray proposed to diminish the number of the trust too far. He was quite satisfied, however, that the present constitution of the trust should be changed, for the following reasons:—That the duties of the town councillors are too multifarious and onerous to permit them to devote the time and attention necessary for the proper management of the affairs of the Clyde navigation. That it is improper, even if they had the time, which they have not, that they should be continued in the management, because the town councillors, as bridge trustees, have an opposing interest to the Clyde trustees; and as police commissioners they have already taken the management of the Clyde police out of the hands of the navigation trustees, in defiance of a report against such a measure by the Government Commissioners appointed to examine into the affairs of the Scottish Royal Burghs in 1836; and they have destroyed the check upon the influence of the town council in the navigation trust which Government had inserted in the Navigation Acts. That as bridge trustees, the town councillors, in their anxiety to erect a new bridge at Stockwell-street, which is totally unnecessary, as the present bridge is perfectly secure, and its width much greater than the crooked lane into which it leads, have implicated the Clyde trustees in a submission, on an action of damages by the bridge trustees against the Clyde trustees, for, by their operations, having affected the stability of that bridge—an allegation altogether unfounded, and which the preamble to the Act, which the town council as bridge trustees this year procured to rebuild the bridge, refutes; and which the bridge trustees would never dared to have advanced in a court of law. The aspect of this submission is at present, to the Clyde trustees, of the most serious character. For these and other equally cogent reasons, such as the political character which must always attach to a municipal council, and which ought not to obtain in a trust so entirely mercantile as that of the Clyde navigation, he would strongly recommend that the town council be confined to its own duties, and that a new Board of Clyde trustees be constituted, and which, he respectfully submitted, should be taken from the following sources:—

1st, One trustee or commissioner, not being a town councillor, to be elected once in every two years by the ten-pound electors of the 16 municipal wards.

2nd, Two commissioners to be named by each of the Corporations of the Merchants'-house and Trades'-house. The Lord Provost, the Dean of Guild, and the Deacon Convener, to be, in addition, trustees *ex-officio*.

3rd, The Chairman of the Chamber of Commerce, the Chairman of the Corporation of Underwriters of Glasgow, and the Collector of Customs for the port.

Lastly, Two trustees, citizens of Glasgow, to be named by Government—twenty-eight trustees in all, being five less than the present Board of thirty-three. The Lord Provost to be chairman, and the power of re-election to be vested in the constituencies; and that the Board, so constituted, shall have the entire and sole power and control of and over their officers—over their secretary, engineer, treasurer, and collector; and that these officers shall not be permitted to hold any other office or place of emolument, either under the Clyde trustees or any other parties, public or private; and all other inferior permanent officers in like manner. A district consulting engineer, named by the Government, would be a great benefit in assisting with his advice and counsel the local engineer.

The COMMISSIONER, after thanking the gentlemen for their attendance and the information they had afforded, said he had only now to pronounce the inquiry closed; and, whatever might be his opinion as to what might have been done, or was still wanted, it was but justice to say that, in the course of his experience, he had never found any river so improved as the river Clyde and the harbour of Glasgow.

(*Adjourned.*)

No. 318.

Return by the Parliamentary Trustees of the River Clyde and Harbour of Glasgow, of Acts of Parliament, Reports, Plans, &c., relating to the Port.

No. 318.
Return of Acts of Parliament, Reports, Plans, &c.

Glasgow, April 17, 1845.

I.—Titles of Statutes under which the Trustees have acted and now act.

1. An Act passed in the 32nd year of King George II. cap. 62, intituled "An Act for improving the Navigation of the River Clyde to the City of Glasgow, and for building a Bridge cross the said River from the said City to the Village of Gorbells."
2. An Act passed in the 10th year of King George III. cap. 104, intituled "An Act to explain and amend an Act made in the thirty-second Year of the Reign of King George the Second, for improving the Navigation of the River Clyde to the City of Glasgow, and for building a Bridge cross the said River from the said City to the Village of Gorbells."
3. An Act passed in the 49th year of King George III. cap. 74, intituled "An Act for explaining and amending two Acts for improving the Navigation of the River Clyde to the City of Glasgow."
4. An Act passed in the 6th year of King George IV. cap. 117, intituled "An Act for amending three Acts for enlarging the Harbour of Glasgow, and improving the Navigation of the River Clyde to the said City; and for other Purposes therein mentioned."
5. An Act passed in the 3rd and 4th year of Her Majesty Queen Victoria, cap. 118, intituled "An Act for further deepening and improving the River Clyde, and enlarging the Harbour of Glasgow, and for constructing a Wet Dock in connection with the said River and Harbour."

APPENDIX C.

GLASGOW.

No. 318.
Return of Acts of Parliament, Reports, Plans, &c.

II.—The Parliamentary Plan by James Walker, Esquire, LL.D., F.R.S. L. & E., Civil Engineer, London, deposited with reference to the Act 3 & 4 Victoria, cap. 118, being the plan under which the operations are now proceeding,—a copy of which plan is now sent.

III.—Reports by Engineers, of which copies are sent.

1. Reports by various Engineers from the year 1752 to the year 1834.
2. Report by Mr. David Logan, civil engineer, in 1835.
3. Report by James Walker, Esq., civil engineer, 1836.
4. Report by John Scott Russell, Esq., 1838.
5. Report by Mr. William Bald, civil engineer, 1844.

N.B. The Trustees are not aware of any "complaints" as to the defects of the harbour, although a general desire has been expressed by the trade for a more enlarged harbour accommodation.

Returned by
A. TURNER, *Secretary to the Clyde Navigation.*

To the Hon. H. Manners Sutton.

No. 319.

Report of J. SMEATON, Esq., C.E., *relative to the Deepening of the Clyde.*

Facts relating to the River Clyde.

No. 319.
Smeaton, on the deepening of the Clyde.

September 3, 1755.

1. SEPTEMBER 3, 1755, being the third day after the equinoctial full moon, the river low after a drought, and the wind easterly, the Clyde was sounded upon twelve different shoals between Glasgow and Renfrew, both at low and high water. The two shoalest places were at the Hirst, a little below Glasgow, and Point-house Ford; the former having one foot six inches, and the latter one foot three inches at low water. The soundings at the three lowest shoals—viz. Marlin Ford, Blarthill Sand, and Spoydoch Ford, near Scotstown—were one foot six inches each. At high water, the same day, Spoydoch had six feet, Blarthill four feet nine inches, Marlin Ford four feet nine inches, Point-house Ford three feet eight, and the Hirst three feet three inches.

2. The declivity of the river appeared very gentle even upon the shoals, and almost stagnant, as to appearance, at the deeps.

3. That Marlin Ford is the only firm ground between Point-house Ford and Spoydoch.

4. That the River at Marlin Ford is not more than 684 feet wide.

5. That the River at Spoydoch is 884 feet wide.

6. That the ordinary neap tides are sensible at Glasgow bridge.

7. That at Marlin Ford the ordinary neap-tides rise two feet, so as to make three feet six inches depth of water there.

8. That at Spoydoch the ordinary neap-tides rise two feet six inches, so as to make four feet water there.

9. That at Marlin Ford the shores are bold and full, particularly on the south side.

10. That at Spoydoch the shores are flat and low, particularly on the south side.

11. That Blarthill sand is a ridge of quicksand, of small extent.

12. That Spoydoch Shoal is a ridge of hard gravel, of small extent.

13. That the pool or deep between Marlin Ford and Blarthill Shoal contains a sufficient depth of water to keep up such vessels, as usually come up the Clyde, afloat at low water.

14. That from Point-house Ford to Marlin Ford is almost one continued shoal of light sand.

15. That the navigation is free at ordinary neap-tides, as far as Spoydoch Shoal, for vessels that do not draw above four and a half feet water.

From a due consideration of the facts above recited, it appears to me that Marlin Ford is the most proper place for a lock and a dam, in order to secure four and a half feet water at all times, up to the quay at Glasgow. My reasons for this opinion are as follows:—

1. Blarthill and Spoydoch Shoals being the only places below Marlin Ford where the vessels are obliged to stop at neap-tides (f. 15), and these being defective but by half a foot, or at most nine inches (f. 8), I apprehend both these will be remedied by the proposed work at Marlin Ford: for (f. 6 and 7), as the neap-tides are sensible at Glasgow bridge, and rise two feet at Marlin, a large body of water must at these times flow into the river from Marlin to Glasgow, which will be stopped by the proposed dam: the consequence that may be expected will be, that the tide, being prevented from spending itself up the river, will accumulate for some miles below the dam, and rise at least one foot higher upon Blarthill and Spoydoch Shoals than it otherwise would have done, and thereby make a sufficiency of water for the vessels to go over them at neap-tides. That this will be the case in some degree is agreeable to reason and experience. But suppose the worst—that the increase of tide upon Blarthill and Spoydoch should fall short of nine inches, which is requisite, these shoals might easily be cured by other means. As to the shoal at Blarthill, it is a narrow ridge of quicksand (f. 11), which is thrown up by the strength of the current, in the flux and reflux of the tide. As therefore the dam will, in great measure, cut off the current made by the tide at this place, in all probability this ridge will subside in consequence thereof, and become sufficiently deep. But in case this should not come to pass, this shoal might be infallibly cured by a weir brought from either side of the river, so as to make a contraction upon the shoal, which, by confining the current at low water, will be sure to carry away the sand to any depth required. The method of making these weirs is by a double hedge filled between with fascines and stones, in the manner that is represented at the tail of the proposed cut, and they are executed at very moderate expense. The construction of weirs in like cases is a thing well known and often practised in the navigable rivers in England. As to the Spoydoch Shoal, the evident cause of its continuance is the hardness of the ground (f. 12), which, being a ridge of stony gravel, (considering the wideness of the river in this place,) neither the reflux of the tide nor the spates have been sufficient to carry it away; but as at low water it is only 18 inches deep, and the ridge not broad, a channel may be cut at small expense, in case it is needed, half a foot or 9 inches deeper, for the vessels to pass through. And this channel will preserve itself open, as the chief current of the river will go down it, especially at low water.

2ndly, As the river at Spoydoch is almost one-third wider than at Marlin (f. 4 and 5), and as it

No. 319. Smeaton, on the deepening of the Clyde.

will be requisite to raise the dam at Spoydoch 1 foot higher than at Marlin, in order to give the same water upon the Hirst (f. 1); as likewise the ground is less proper for building coffer-dams at Spoydoch, and attended with other inconveniences, I judge it will cost 2000*l.* more to perform the work at Spoydoch than will be necessary in case it is performed at Marlin Ford.

3rdly. The shores being much more low and flat at Spoydoch than at Marlin (f. 9 and 10), the ground adjacent to the former place will be much more liable to damage by the spates, as the surface of the ground on the south side will be less than 2 feet higher than the surface of the water, when raised by the dam to the necessary height.

4thly. The dam, &c., ought not to be higher than Marlin Ford, because there is no firm ground to place it upon, till Point-house Ford (f. 3), which is so far up the river, that the neap-tides would be too far spent in running up thither, to produce a sufficient accumulation to carry the vessels over the flats that reach almost the whole distance from Marlin to Point-house (f. 4).

As the declivity of the river at low water is very gentle (f. 2), and as the rise of the tide at Marlin was 1 foot 6 inches greater than at Hirst (f. 1), we may conclude, that if a dam be raised at Marlin as high as the top of the tide, that this will pen the water upon the Hirst to 3 feet 3; and, of consequence, if a dam of 6 feet is built at Marlin, this will raise the water at the Hirst to 4 feet 6; and allowing the water to run over the dam in a sheet of 3 inches thick, this will make at the Hirst 4 feet 9 inches: for the high-water mark at Marlin may be somewhat below the dead level of the high-water mark at the Hirst; yet as current waters always require a declivity, I apprehend we may safely rely upon it, that a dam raised 6 feet at Marlin will always secure at least 4 feet 6 over the Hirst Shoal. But in case the water should prove a little defective at the Hirst, which is the only place where it can happen, as the bottom there is a stony gravel, it may be deepened 6 inches at a small expense, and the channel will keep open for the same reason as at Spoydoch. But even if it should be found requisite to raise the water higher at Marlin than 6 feet, I apprehend it would be more eligible to do it by adding a water-board of 6 or 8 inches to the crown of the dam, which may be made use of in dry seasons, and taken away in winter, when not needed, as is done in many places in England, rather than endanger the flooding of the adjacent grounds by raising the main body of the dam too high.

Between Marlin Ford and Blarthill Shoal is an extensive deep or pool, capable of keeping the vessels afloat at low water (f. 13). It therefore seems proper to lay the kyles and floor of the lock 4½ or 5 feet below the low-water mark, and to dig the cut below the lock to the same depth; and, by letting off the water at the lock, to scour a clear passage at the tail of the cut, so that the vessels may pass and repass from the lock to the deep at low water, which will serve as a basin for the vessels to lie in, ready to take the first of the tide in order to pass the shoals below.

The lock walls are designed to be faced with well broached ashlar, and backed with rubble to 5 feet thick at a medium, and the whole filled solid with cement of terras. The width is proposed to be 18 feet in the clear, and to take in a vessel of 70 feet long, which is sufficient to let pass a flat-bottomed lighter, at 4½ feet draft of water, of above 70 tons, or to let pass a sloop or brig of above 100 tons, when there is water in the river to admit it.

The dam is designed to be faced with well-broached setters in regular courses, and well filled and packed with rubble, but the whole laid without mortar. The water is to be prevented from leaking through the stone-work by a sheating of boards through the heart, raised upon a file of blank piles, driven so as to be water tight. The breadth of the dam at the base is intended to be 18 feet, and the setters to be footed at each side upon a half tree of wood, well secured with rows of piles. And to prevent the natural gravel from washing from under the work, the lower half tree is to be furnished with a sheet of dove-tailed plank piles; and the four rows of piles being all connected together by cross straps of wood, so that no part can give way without the whole being torn up together, the stonework will become immoveable.

J. SMEATON.

No. 320.

Report of JOHN GOLBORNE, Esq., *relative to the Deepening of the River Clyde and Harbour of Port Glasgow.*

Chester, Nov. 30, 1768.

No. 320. Golborne, relative to the deepening of the Clyde.

PURSUANT to the directions of the magistrates of the City of Glasgow, I went to Port-Glasgow, and, having examined the state of that harbour, find the basin much filled up with mud brought in with the river, which, in time, will be totally lost, if some means are not used to scour it away.

In order, therefore, to remove it, I searched the adjacent heights, and found a stream of water, which at present supplies a mill near the town; this water may be easily conveyed to the basin, and, by strengthening and raising dams of two reservoirs, such a quantity of water may be pent up there as will be sufficient to scour the basin; but, previous to this, I would recommend that a pier be extended down the middle of the basin, opposite the entrance, which would be of great utility, as four vessels, two on each side, might discharge at the same time. I would also propose, that two sluices, one on either side of the pier, should be fixed in the wall of the present quay, to make a scour at low water, by which a channel on either side of the pier would be constantly kept open.

This basin, indeed, might be converted into a wet dock, by strengthening the north wall, and fixing a pair of gates on the entrance to pen up the tides; but, as the common spring-tides do not flow more than 11½ feet, there would scarcely 11 feet of water flow into the dock, which, I humbly conceive, would be sufficient for the generality of vessels using that port.

If it should be thought advisable to carry this scheme into execution, a pier may be extended 1200 feet from the Castle of Newark towards low water, which would form a very capacious basin for vessels to lie in. But as I am an entire stranger to the trade of this port, the utility of a wet dock and the capacity of the basin must be determined by those conversant with it.

By the plan of the River Clyde, now before me, I find that the first obstruction to navigation is Dumbuck Ford. That the river divides itself into two channels opposite to Longoch Point—one proceeding nearly in a right line, the other being very crooked, after running nearly a mile, joins the north channel. That, from the said junction, the depth gradually decreases to 2 feet at the point of division, where a bar extends over both channels; the depth then gradually increases to 16, 18, and even 24 feet, opposite Dunglass Castle.

GLASGOW.

No. 320.
Golborne, relative to the deepening of the Clyde.

The next shoal is Kilpatrick Sands, on which there are not more than 2 feet water; from hence to Nushat Island there are not less than 8 feet; but the bed of the river, for the whole length of the island, is hard gravel and large stones, which the current cannot penetrate, and at each end there are not more than 2 feet water.

Blarthill-holm Sands and Winholm Sands have soft sandy bottoms, 1½ foot deep. Pudzeck, Marling Ford, Pointhouse, and the Hirst, have hard gravelly bottoms, and are 2 feet deep, except the latter, which has not more than 1 foot of water on it.

The River Clyde is at present in a state of nature, and, from want of due attention, has been suffered to expand too much, for the sides in most places being much softer than the bottom, the current has operated there, because it could not penetrate the bed of the river, and has by that means gained in breadth what is wanted in depth.

I shall proceed on these principles of assisting nature when she cannot do her own work, by removing the stones and hard gravel from the bottom of the river where it is shallow; and, by contracting the channel where it is worn too wide, for quantities of sand brought down by the spates form banks in the channel, to the great detriment of the navigation.

The first and grand obstacle is Dumbuck Ford, where the river dividing itself into two channels, the re-flowing current is greatly weakened, and the bottom, being covered with a crust of hard gravel, cannot be worn down to a proper depth; but if a jetty were extended from Longoch Point over the south channel to confine the current, and the hard crust of gravel removed by dredging, the reflowing current would then act with greater force, and soon grind down a deep and capacious channel; and this must plainly appear to any intelligent person who casts his eye over the plan of the river and observes the soundings, because, from Port-Glasgow to the foot of Dumbuck Ford, there are not less than 12 feet at low water; but from the place where the channel divides itself the depth gradually decreases to 2 feet, and a bar extends over both channels; but no sooner are they united than the depth increases to 16, 18, and even 24 feet opposite Dunglass Castle. Hence, it appears, that if Dumbuck Ford were removed, vessels of large burthen might come up to Dunglass Castle at quarter flood; and, were a quay constructed along the river side, the largest ship might lie afloat there at low water and be discharged in safety. The next obstruction is Kilpatrick Sands, which may be easily removed by contracting the channel; but I am humbly of opinion but Dumbuck Ford being removed, a greater momentum will be given to the reflowing current, so as to grind down those sands considerably; however, contracting the channel will remove the cause, and the effects must cease. From Kilpatrick Sands to Nushat Island, we have from 10 to 8 feet low water. Now, as the spring-tides flow 6 feet, and the neaps 4, it follows that there will be 14 feet in spring-tides, and 12 feet in neaps, at the foot of Nushat Island, and this depth, in all probability, would have extended upwards, had not nature thrown a bed of large stones and hard gravel from one end of the island to the other, which the current cannot remove, so that there are not above 2 feet water at each end of the island. These stones and gravel being removed, the current will soon grind down a deep channel; let us only suppose 5 feet, and as the spring-tides flow 6, and the neaps four feet, it follows that there will be 11 feet in spring-tides, and 9 in neaps at the Barns of Clyde. Blarthill-holm Sands and Winholm Sands have soft sandy bottoms, and will be removed by contracting the channel. Marling Ford, Pointhouse, and the Hirst, have hard gravelly bottoms, which must be removed by dredging or ploughing.

By these means, easy and simple in themselves, without laying a restraint on nature, I humbly conceive that the River Clyde may be deepened so as to have four, or perhaps five feet depth up to the Broomielaw at low water; and I am humbly of opinion, that, by removing these several obstructions, the surface of low water will be lowered considerably. Let us suppose one foot only. By general estimation there is a difference of two feet only between the rise of spring and neap-tides in the river Clyde; but at the Broomielaw there is a difference of nearly three feet, and I shall endeavour to account for it. The tide, at full and change, flows till twelve o'clock at Port-Glasgow, and till two at the Broomielaw; hence there is two hours difference in the time of high water at those places, or, in other words, it has ebbed two feet at Port-Glasgow before it is high water at the Broomielaw. Now, the spring-tides flowing much more quickly than the neaps, rise three there; but the latter, not being impelled with that force, are languid, and do not flow so quick, and consequently are not raised so high, and the great breadth of the river contributes not a little to this evil, because the tide, having but a given time to flow, cannot fill that large space before the reflux comes on. When the river is confined to a proper breadth by jetties, the intermediate space will be filled up with sand carried down by the spates and the fitts brought by the tides, and become firm land. In proportion, then, as this happens, the neaps will rise higher at the Broomielaw, so as to bear a due proportion with the other parts of the river. I have before observed, that the surface of the low water would be lowered one foot, and the neaps flowing one foot higher, these added to four feet, the depth at low water, make six feet at neap, and nine feet at spring tides at the Broomielaw. From the observations I made during my short stay, I am induced to think that the tide coming from the sea has not an ample and sufficient communication with the Frith of Clyde. Could a better inlet be given to it, I humbly conceive that it would flow considerably higher at the Broomielaw. This is a matter worthy of attention.

Before I proceed to estimate the expense of the several works necessary to improve the navigation, I must beg leave to observe, that it is difficult, if not impossible, to be very exact in estimates of so complicated a nature, when we are continually subject to the tide and sundry accidents which human understanding can neither foresee nor prevent; and though I have made an allowance for them, yet it may so happen that the expense may exceed the sums set down in the following estimate; nevertheless, the great advantage that must arise from it to the City of Glasgow will, I flatter myself, greatly overbalance the expense, should it even cost 10,000*l.*

An Estimate of the Expense of Improving the Navigation of the River Clyde.

	£.
To contracting the river with jetties, being eight miles, at 400*l.* per mile	3200
To extending a jetty from Longoch Point over the South Channel	1260
To contracting the channel at Kilpatrick sands	1000
To dredging and deepening Dumbuck Ford	500
To dredging and deepening the other fords	1000
To building three sets of punts to carry stones, at 80*l.* each	240
To 20 per cent. on the whole, for unforeseen events, utensils, and engines	1440
	£8640

APPENDIX C.

GLASGOW.

No. 320.
Golborne relative to the deepening of the Clyde.

Estimate for making the present Basin at Port-Glasgow into a Wet Dock.

	£.
To 10,320 feet, at 8*d.* per foot	344
To 1560 yards of Masonry, at 1*s.* per yard	78
To 1200 ditto of earth, at 4*d.* per yard	35
To a pair of gates, &c., &c.	500
To digging down and staunching round the dock	150
To unforeseen events, utensils, &c., at 15 per cent.	166
	£1273

If this basin is converted into a wet dock, there must be a harbour for ships to lie in, and a very commodious one may be formed (as I have before observed) near the Castle of Newark, by building a pier 1200 feet long, 15 high, and 50 wide. On the top a quay must also be built, to extend 300 feet long towards the present dry dock. The expense will be as follows:—

	£.
To 54,000 feet of ashlar work, at 8*d.* per foot	1800
To 9000 yards stone-work, at 2*s.* 6*d.* per yard	1125
To 31,200 yards of earth, at 4*d.* per yard	520
To 4600 yards of paving, at 6*d.* per yard	105
To unforeseen events, utensils, and engines, at 10 per cent. on the whole	354
	£3904

There also will be a necessity for bringing down a stream of water to keep open and cleanse the harbour and wet dock, the expense of which, with proper sluices, &c., will amount to 500*l.*, exclusive of the purchase of any land.

	£.
Converting the basin into a wet dock will cost, as per estimate	1273
The pier	3904
To bringing down a stream of water to scour the harbour	500
	£5677

Having observed, in the former part of my report, that I much doubted whether the tide flowed high enough at Port-Glasgow for laden vessels to get into the dock at common spring tides, therefore, as I cannot recommend that scheme, I shall make an estimate for extending a quay or wharf 200 feet from the present quay into the basin opposite the entrance:—

	£.
To 2850 feet of ashlar work, at 8*d.* per foot	385
To 1608 yards of stone work, at 2*s.* 6*d.* per yard	201
To 4860 ditto of earth, at 4*d.* per yard	81
To 800 ditto of paving, at 6*d.* per yard	20
To unforeseen events, utensils, and engine	59
	£646
To bringing down a stream of water to scour the harbour	500
	£1146

To bringing down a stream to scour the harbour, and the expense of projecting a quay or wharf into the basin, amount to 1146*l.*, which I apprehend will tend greatly to the improvement of the present harbour, if it is found to be sufficiently capacious.

JOHN GOLBORNE.

No. 321.

Report by J. WATT, Esq., *to the Magistrates and Council on the State of the River.*

Glasgow, October 20, 1769.

No. 321.
Watt, on the State of the River, 1769.

AGREEABLY to the desire of the magistrates of Glasgow, I have, accompanied by Mr. James Berry, examined the declivity of the bed of the River Clyde, from the Broomielaw Quay to Dumbuck Ford, according to Mr. Golborne's directions.

As there is no certainty of being able to return exactly to the same place of any ford, I thought it necessary to set out from some fixed point, and made choice of the stone in the quay, which is next to the paling at the turnpike. The Hirst Ford is lower than that stone eight feet. The following table shows how much the other fords are lower than the Hirst:—

	Ft.	In.
The lower end of the Hirst, opposite to the Brewery Quay	0	10
The top of the Windholm Sand	0	6
The lower end of Govan Ford, which is a continuation of the above sand	1	7
The Pointhouse Ford	0	11½
The highest part of Holm Sand	1	3
The lowest part of ditto	1	9
The Marling Ford	2	3
The Blarthill Sand	2	2
The Pudzock Ford	3	1
The upper Nushat Ford	3	9
The lower ditto, a little above Dalmuir-Bay	4	5
The bottom, 300 yards below ditto	7	5
Erskine Sands	5	10
The lower water, 100 yards below the lower Cairn at Dumbuck	4	0
The highest part of Dumbuck Ford	5	5

APPENDIX C.

GLASGOW.

No. 321.
Watt, on the State of the River, 1769.

The depth opposite to Dunglass Castle at low water is 12 feet, and there are some holes much deeper, yet that is what may be called the general depth. Being obliged to take the fords in the course of levelling, it was impossible for me to be at them all exactly at high or low water. I have, however, made the following observations on some of the most important of them, and added the accounts given of them by Mr. Smeaton, who, in the year 1755, took the depth at high and low water, in the same spring tide, in all the fords from Pudzock to the Hirst; and, in 1758, took the difference of those from Pudzock to Dumbuck. I apprehend his observations to be very accurate, and to be depended on.

1st. On Tuesday last, being a spring tide, the river very low, I found that at low water there was, on the Hirst, 1 foot and 2 inches; on Windholme Sand, 1 foot 5 inches; on the lower end of ditto, 2 feet 3 inches; and on Pointhouse Sand, 1 foot 4 inches. At high water, the same tide, there was, on Martin Ford, 5 feet 4 inches, but that depth was of small extent, increasing above and below to 5½, 6, and 7 feet. This, and indeed all the hard fords are very uneven in the bottom, which makes it difficult to ascertain their soundings.

2nd. In the preceding tides, where the river was not quite so low, I found that the shallowest place of Dumbuck Ford (which is near the uppermost cairn) had two feet water at low water, and that it continued near that depth for 130 yards or thereabouts, where it deepened both above and below to 3 feet, and to 4 feet at the lowest cairn, and that there was in all a space of 600 yards in which the depth is not more than 3 feet.

3rd. Measuring upwards of 750 yards from the lower cairn, there is a rise in the surface of the water of 10 inches, which makes this the greatest declivity in the river.

4th. It appears from Mr. Smeaton's observations, and the above levels, that the tide in the upper part of the river rises above the true level, particularly after it passes the Pointhouse.

5th. These levels differ from a level taken by Dr. Wilson, as far as the Marlin Ford, in the year 1758. Dr. Wilson's notes of the particulars of that level are fallen by, but as far as he or I can recollect, he did not set out from the highest part of the Hirst, having been misinformed concerning the place of that shoal, he has been so kind as to accompany me to an examination of the level as far as Marlin Ford, which we find to be as hereby given.

Here follows the tide as taken by Mr. Smeaton:—

	High Water.		Low Water.		Difference	
	Ft.	In.	Ft.	In.	Ft.	In.
The Hirst . . .	3	3	1	3	0	0
Pointhouse . . .	3	8	1	6	0	5
Holm Sand . . .	4	0	1	6	0	9
Marlin Ford . . .	4	0	1	6	1	6
Blarthill Sand . .	4	9	1	6	1	6
Pudzock . . .	6	0	1	6	2	9

By Mr. Smeaton's observations in 1758 the differences of the other fords from the Hirst are—

	Ft.	In.
The Upper Nushat . . .	3	5
The Lower Nushat . . .	4	1
Erskine Sands . . .	8	4
Dumbuck Ford . . .	5	1

I have, in the course of this survey, been much indebted to Mr. Berry's knowledge of the river and fords, and the observations formerly made, and also for his assistance in the present observations.

JAMES WATT.

No. 322.

Report by J. GOLBORNE, Esq., C.E., *relative to the Improvement of the River, and Estimate.*

No. 322.
Golbome, on the Improvement of the River.

Chester, September 7, 1781.

THE Magistrates of Glasgow being desirous to know if a greater depth of water could be brought to the Broomielaw Quay, so as to receive vessels trading to England and Ireland, I attended them at their annual sounding of the river, and it gave me great pleasure and satisfaction to find the general work in such good order and condition, and to observe that the spaces between many of the jetties were filled up and covered with grass, to the great emolument of the proprietors, and advantage of the river; for, in proportion as the sides fill up and become land, the neap-tides will rise higher, and the land-floods being more confined, will act with greater force on the bottom, so that by lengthening the jetties in some parts, and raising them in others, a greater depth may be obtained; but in doing this due attention must be paid not to make them project irregularly, as eddies would be thereby formed hurtful to navigation; and so fully convinced were we of the good effects that would arise from confining the river, that in the first Report, dated November, 1768, are these words:—"When the river is confined to a proper breadth by jetties, the intermediate space will be filled up with sand carried down by the spates, and silt brought up by the tides, and become firm land; in proportion then as this happens, the neaps will rise higher at the Broomielaw." I must now further add that this will continue to increase until the neaps bear a due proportion to the spring-tides. I observe in many places that the silt brought down by the spates has already raised the land, so as to cover and bury the jetties. In all such parts they should be raised and extended to the land, which would have a very good effect; for I find, by experience, that rivers in general have a depth in proportion to the height of their shores. This is strongly illustrated in several instances in the Clyde, particularly in the Holm Sands, at the head of the White Inch, (a tract of low land), where a proper depth is with difficulty maintained, entirely owing to its low situation, whereas a little higher up there is a bold shore not subject to be overflowed, which, confining the current, keeps open the deep channel. It gave me great pleasure to observe that the channel at Dumbuck has considerably increased its depth since I removed the Ford. The tide ebbs considerably lower at Dunglass Castle, and Kilpatrick Sands are thereby worn down two feet at least. In September, 1772, I was desired by the magistrates to estimate the expense of making Dambuck Ford 6 feet deep and 300 feet wide at low water; the estimate amounted to 2800*l.*

APPENDIX C.

GLASGOW.

No. 322.
Golborne, on the Improvement of the River.

I contracted to do it for that sum, though I was somewhat intimidated by Mr. Smeaton's Report, who had visited it in 1758, and after stating sundry facts draws this conclusion—"From a due consideration of the facts above mentioned I am of opinion as follows: That the deepening of Dumbuck Ford 6 feet to make 14 feet of water, or even 4 feet to make 12 feet at common tides, with a sufficient channel for ships to the length of more than half-a-mile, (being in the tide way,) will be a work not only of great time and labour, but will be attended with an expense which is not easy to compute, and even when once computed, it is not certain whether it will be kept open; for as the north channel, wherein this operation is the more practicable, is chiefly sand and slush, it has most probably been formed from the flux and reflux of the tides, and if so, will most certainly form again; all known methods for the prevention thereof being perfectly uncertain in so open a place and so much in the tide's way." I began this work on the 1st day of June, 1773, and finished it in the beginning of November following, to the satisfaction of the magistrates, who on sounding did not find less than seven feet of water on it; and on sounding it again with the magistrates on the 8th day of August, 1781, at low water, we had the pleasure to find no less than 14 feet; for the jetty which I had carried over the south channel turned the current so effectually down the north channel, and the machines which I used having cut through the stratum of clay into the sand, it was in many places from 20 to 22 feet deep; and there is no doubt that deep water may be brought up to the foot of the Nushat Isle, by contracting the channel, so as to be capable of receiving vessels of 200 or 300 tons burthen, which would certainly be of great advantage, not only to the city of Glasgow, but also to the Great Canal, when it shall be made to communicate with the River Clyde. If I am rightly informed, two-thirds of the tonnage will arise from coal. If this be a fact, all possible encouragement should be given to that trade, and if vessels of burthen should come up to Knightswood Quay and load coal, the income of the tonnage would be thereby increased, probably so as to pay the extra expense, and in other respects be of great public utility. I would, therefore, propose that the river should be deepened three feet from the foot of the Nushat Isle to Knightswood Quay, which would make ten feet of water to that place. The bottom of the river for the whole length of the Nushat Isle is hard gravel and stones, which can only be deepened by machines, as was formerly done when we made it seven feet deep. But as ten feet are now required, it will be necessary to deepen it three feet at least to Knightswood Quay, and two feet from thence to the Broomielaw Quay. In order to obtain this depth it will be necessary to contract the channel by extending the jetties, the current will then deepen the soft part, and when the bottom is hard gravel or clay, it must be removed by the machines. If it shall not be thought proper to raise a sum of money for carrying on these works, let an estimate be made every spring, in the month of March, of the sum required to repair the damage done to the jetties by the ice, and let the surplus be laid out in new works, beginning at the lower end of the river; this will be a slow but sure method of proceeding. During my stay at Glasgow I sounded the river several times that I might be enabled to form a proper judgment, not only of what was wanted to preserve the established depth, but also some of the works necessary to bring the deep water to the foot of the Nushat Isle. The former amounts to the sum of *71l.* *15s.* *6d.* the latter to *348l.* *12s.*; in the whole, making *420l.* *7s.* *6d.* I took the liberty of directing Mr. John Bennet to proceed immediately to the former works, and to do as much of the latter as could be accomplished before winter sets in, as I apprehend so much may be spared from the income of the tonnage.

Before I quit this subject, I must beg leave to observe, that the fall through the new bridge ought to be taken away by cutting down the piles, and removing the other obstructions in the three largest arches, so that the water above and below the bridge might be brought to the same level. This would cause the neap tides to flow upwards, and therefore increase their velocity to the advantage of navigation. Another great convenience would arise from it, as the spates would soon deepen the space between the two bridges, so that boats loaded with fish, and other small craft, might go up to the other bridge to the great convenience of the inhabitants; 20 yards of the breast wall might be underbuilt, which would form a quay for them to lie at, and to come at small expense. I observe that a store-house is much wanted at Blarthill, for keeping the materials belonging to the community. I long pleased myself with the idea of coming from thither to pay my respects at Glasgow, and view the state of the river. The generous treatment I met with in completing my work has made a lasting impression on my mind, and I hope that the small tribute of my endeavours to promote the trade and navigation of the opulent and flourishing city of Glasgow will be accepted as the overflowing of a grateful heart.

JOHN GOLBORNE.

Estimate of Work necessary to preserve Seven Feet Water to the Quay of Glasgow.

		Yards.	£. s. d.
3	jetties lengthened 8 yards each near Knightswood Quay	24	
1	„ „ 8 „ west end of Buckinch Isle	8	
2	„ new 20 „ „	40	
1	„ „ below Linthouse Side	35	
4	„ lengthened south side, head of Holm Sands, 8 yards each	32	
	„ new, between the Holm Sands and Quay Burn, 25 yards each	50	
1	„ lengthened at Paisley Water Mouth, 72 yards	72	
		261 at 5*s.* 6*d.* =	71 15 6

Estimate of Work necessary to bring deep Water to the Foot of the Nushat Isle.

		Yards.	
1	jetty below Lord Blantyre's house	240	
1	„ opposite	156	
3	„ below Dalnotter, to be lengthened	180	
1	„ below Lord Semple's house	120	
1	„ below Mr. Campbell's March Dike	250	
1	„ at the east end of little Nushat Isle	50	
		996 at 7*s.* =	£348 12 0
			£420 7 6

N.B.—I pointed out to John Bennet, on the spot, where the several jetties are to be made.

APPENDIX C.

GLASGOW.

No. 323.

Rennie, on obstructions in the Clyde, near the New Bridge.

No. 323.

Report by JOHN RENNIE, Esq., *respecting obstructions in the River Clyde, near the New Bridge.*

London August 22, 1799.

MY LORD AND GENTLEMEN,

I HAVE examined the River Clyde between the old bridge at Glasgow and the town of Renfrew, and have been furnished by Mr. Spreull, your chamberlain, with a plan and several sections of the river between the Washing-Green and the Jetty, No. 100, on the south side of the river, and with drawings of the old bridge, as it was, before the alterations in the year 1776, and as it is now; and also with a plan of the river between the old bridge and the lower end of the Broomielaw, before the new bridge was built or the navigation improved, together with a plan of the new bridge itself,—and I have considered the same, and compared them with my own observations made in the end of October last.

It is not very easy to say anything decided respecting the state of the River Clyde previous to the year 1768, which was before any of the works were begun; for, although I have made all the inquiries I could, and examined not only the plan above mentioned, but also the Reports and Soundings of Messrs. Watt and Golborne, yet, as the datum from which these soundings were taken has been in great part removed, I found it impossible to ascertain whether the sections of the river were greater then than now, when the width is contracted. Thus much is certain, that the depth has been greatly increased, as will appear by comparing it with the soundings mentioned in the Reports referred to above; therefore it is probable that the real section is greater now than it was previous to the year 1768; for, although it is allowed by every person with whom I have conversed that the floods in the Clyde are higher now than formerly, yet it does not follow from thence that the additional height arises either from the building of the new bridge, or the works for the improvement of the navigation.

Had the country adjoining the Clyde above Glasgow, or, in other words, that which drains into it, remained in the same state in which it was previous to the year 1768, and had it been found that the floods were higher at Glasgow than before, there would then have been no difficulty of ascertaining the cause of the extra rise. But as the country has been greatly improved by draining, and converting large tracts of land into arable and meadow, it is evident the rain which now falls on its surface will be carried off more rapidly than before, and of course will increase the height of the floods, but will diminish their duration. Previous to these improvements, the rain which fell on the surface could only make its escape to the river by slow degrees, and consequently would not raise the floods to so great a height; but they would continue longer. On this account, therefore, it becomes no easy matter to ascertain what part of the extra height of the floods arises from the works for the improvement of the navigation of the Clyde.

In comparing the water-way of the old bridge with that of the new, it appears that, even with the obstructions in the two arches on the south side of the new bridge, (which are so grown up with mud that no water runs in them, in the ordinary state of the river,) the water-way is greater in the proportion of 60 to 67; and if they were properly opened it would be much more. The whole area through which the great flood in March 1782 passed is greater in the new bridge than the old, in the proportion of 56 to 66; therefore, in point of watering, the new bridge has more than sufficient to pass all that can come through the old bridge.

In comparing the sections of the river itself between the old bridge and the new, at the top of high-water of the tide in the dry seasons of the year, there appears a gradual diminution, in the proportion of ten to eight, just above the new bridge; below it the section increases, and arrives at full size opposite the old crane at the Broomielaw; below this it is considerably more; hence, in the ordinary state of the river, at the high-water of the tide, little or no obstruction, in point of section, arises from the works of the navigation.

In comparing the sections at the height the water was on the 12th of March 1782, the greatest flood ever remembered, it appears (as far as the sections have enabled me to compare) that there is a diminution in the section of the river and banks between the old bridge and the new, in the proportion of 771 to 638. And again, opposite the old crane at the Broomielaw, to 610, from whence it begins to increase, and arrives at full section a little above Springfield Cotton Works.

From these facts it is evident that the flood waters meet with considerable obstructions in the places above mentioned, and, of course, pen the water back on the houses fronting the Ducat Green, and in the Gorbals. It is, therefore, of material consequence to the inhabitants in the lower parts of the city of Glasgow and the Gorbals that they be removed.

The first material obstruction is the advanced bank of the river on the Gorbal shore above the new bridge. This advancement has arisen from deposition of silt which has been made from time to time by the floods; the channel of the river, and of course the currency of the waters, being drawn to the Glasgow side by the works of the navigation, this advanced part should be taken away, according to the red lines marked on the plans and sections.

The second material obstruction is the dyke or weir which has been built across the river, just below the new bridge, to preserve its foundations, the bottom of the navigation below the said dam, and along the wharf at the Broomielaw, being lower, as I am informed, than the foundations of the piers of the bridge. If, therefore, this dyke or weir were to be taken entirely away, the stability of the bridge would be endangered. I cannot help expressing my surprise that the foundations were not laid deeper in the original construction of the bridge, as the same Act of Parliament which empowers the building of the bridge empowers also the improving of the navigation; consequently the deepening of the river should have been foreseen, and the foundations of the bridge laid accordingly. The weir cannot now be taken away; but, as I am informed, it is in very bad repair; perhaps it may, in being rebuilt, be so lowered as to afford a considerable addition of section to assist in carrying off the floods, and whenever it is rebuilt, it ought to be done on a more permanent construction than it is at present. The flooded state of the river, when I made my observations, prevented me from seeing this weir distinctly, and, of course, from being particular about it.

The third is the dyke or jetty which begins on the south side of the river, opposite the Broomielaw, and a little below the old crane, from thence it continues in a curved direction, till opposite the second pier, from the south side of the new bridge. This jetty or dyke should be removed about seven or eight yards further south, to widen the channel of the river so much, agreeably to the red lines in the plan. The alteration will not sensibly diminish the depth of the water in the navigation.

APPENDIX C.

GLASGOW.

No. 323.

Rennie, on obstructions in the Clyde, near the New Bridge.

The fourth is the height of the bank of the river, on the south side below the new bridge, which should be lowered agreeably to the red lines in the plan and sections T U, R S, and P Q, after which it may gradually join to the land by Springfield Cotton Works, where the section is sufficient.

The fifth is a wharf or dyke, opposite Mr. Tod's property, which, although the section of the river is as large there as above, yet it projects so awkwardly into the river as to form an elbow, and, of course, must considerably obstruct the course of the river. This wharf or dyke should also be removed; and should there afterwards be any appearance of a shoal arising in the river at this place, the jetties on the south side may be prolonged, so as to preserve the contraction.

The removal of the bank above the new bridge, the opening of the two arches at the south end of the bridge, the removal of the dyke and wharf opposite to Mr. Tod's property, I apprehend should be done at the expense of the trustees of the navigation; but lowering the river bank on the south side, below the new bridge, should be done at the expense of the proprietors of grounds and houses on both sides of the river, subject to be flooded in time of spates.

These obstructions being removed, I have no hesitation in giving it as my opinion that the alterations which have taken place in the river by the works of the navigation have rendered it more capacious, and, of course, better fitted for carrying off the floods than before they were made.

I must here observe, that although the capacity of the river will be greatly increased by the alterations above recommended, and the floods better carried off than they now are, yet it must not be expected that they will ever be reduced to their former state. This cannot be the case while the present improvements on the lands remain. On the contrary, they will increase as the lands above advance in improvement. All that can, therefore, be done is to clear away the obstructions in the river as much as possible, and thereby put it in a state to carry off the floods in the best manner when they do come down.

I am, &c.,

JOHN RENNIE.

To the Right Hon. the Lord Provost and
Magistrates of the City of Glasgow.

No. 324.

Report by T. TELFORD, Esq., C.E, *on leading up more Tide Water and forming a Dock at the Broomielaw.*

Glasgow, May 24, 1806.

No. 324.

Telford, on leading up the Tide and forming a Wet Dock.

MY LORD AND GENTLEMEN,

IN consequence of an application made to me by your directions, I have, in company with Mr. Spreull, as superintendent on the Clyde, examined the river from the Broomielaw downwards as far as the Long Dyke.

From Mr. Spreull I have received explanations as to the several objects to which my attention was to be directed, and have been furnished by him with satisfactory information, with regard to the operations which have hitherto been carried on, and the effects produced by them upon the river.

Having repeatedly examined and considered the whole, I find that my opinions may most readily be arranged under the following heads:—

1. The leading or bringing up of a greater quantity of tide water.
2. The advantages to be derived from having a tracking or towing-path on a part of the river.
3. Forming a harbour at the Broomielaw.

First, in order to obtain a greater quantity of tide water in the upper part of the river, the general principle is, to reduce the bed of the river to that form which shall afford the most direct course, oppose the fewest obstacles, and render the friction the least possible in regard to the section of the flowing water.

The mode which has formerly been pursued of projecting jetties from each shore for a considerable way into the river is, in my opinion, a very imperfect and improper means of attaining the object in view; the current of the flowing tide strikes upon the lower sides of the jetties in proportion to the velocity with which it is advancing and its angle with the jetties; it, by this means, accumulates and forms a counter current, which checks the velocity of the water which is next advancing, and, not unfrequently crossing the general direction of the tide, meets a similar current from the opposite shore. In the channel of the river, from the repeated contractions and expansions of its section, the water never can retain any uniform velocity; and from these and the before-mentioned impediments, the course of the tide is totally distracted and prevented from rising to the greatest possible height in the upper part of the river. These impediments have also, in some measure, a similar effect in preventing the land-floods from deepening the bed of the river in a uniform manner.

That the river may be brought into the most perfect form, it is necessary that the parallel dykes be completed in the manner which has of late been carried on by Mr. Spreull; his experience and unwearied attention to every part of the river leave me only, on this head, to recommend that the whole may be finished agreeably to the specimens which he has so judiciously executed.

It is advisable that the dykes on the south side of the river, from the city down to Renfrew, should be first constructed, and when this bank shall have been completed, the situation and direction on the north side may be determined, by measuring from the bank on the south side, and bringing the river to a uniform width.

There is reason to expect that the operations here recommended will be the means of bringing up more water, deepening the bed of the river, and facilitating the navigation of vessels; but, besides these, it appears to me to be of the utmost importance to attend to the channel of the river, between the Long Dyke and Port Glasgow; and likewise to the effects produced by the stream of the river Leven, where it enters from Dumbarton. Towards the south shore it is necessary to direct the current of the flowing tides into the main channel. At present, a considerable portion of it runs up to the south of the Long Dyke, and after having accumulated there, returns along its bank a counter current, and checks the tide which flows up the middle of the channel.

It is possible that the banks formed by the water of the Leven may be the means of turning the current of the tide towards the south shore; if so, this might be in some measure prevented by occasionally lowering some of these banks; but it will likewise be necessary to construct a dyke on the south shore, at some place between Port Glasgow and the Long Dyke, and that most probably about where the south channel now commences. The lower point of the Long Dyke is laid down in an im-

APPENDIX C.

GLASGOW.

No. 324.
Telford, on leading up the Tide and forming a Wet Dock.

proper direction: it tends to lead the current of the flowing tide up the south side, instead of directing it into the middle of the channel. This should be altered.

Besides the leading up of more tide water, it may be expected, when the channel is regulated and rendered more direct, that the river will deepen its bed. That this has already in some degree taken place is evident from the increased draft of water with which vessels now come up to the Broomielaw. On the 14th of February last, Mr. Archibald Wilkie, master of the "Harmony," of Liverpool, then lying at the Broomielaw, informed me that he came up with ordinary spring tides, drawing 8 feet 6 inches of water: this was a vessel of 120 tons burthen. That the bed of the river has been scoured is likewise evident from large stones frequently making their appearance in the bottom, which are obliged to be removed.

In those parts of the bed of the river which may be found too compact and hard to be acted upon by the water alone, a dredging-machine may be used with great effect.

Second, I find that, in navigating the river, vessels can come as far as Renfrew with light winds; but the plantations near to Elderslie, by taking off the winds, frequently check the course of the navigation by leaving the vessels becalmed. A tracking or towing-path from Renfrew to the Broomielaw would obviate this difficulty, and by this means vessels would be enabled to take the top or deepest part of the tide; consequently, those of a larger draft of water would come up; and, having the advantage of a horse from the Broomielaw to Renfrew, they would likewise be enabled to catch a stronger current in going down. It is, therefore, evident that, to render the navigation uniform and expeditious, a path should be completed, and horses applied to tracking this district.

Third, having considered what regards the general form of the river, the procuring of a greater depth of water, and the mode of navigating the vessels, it now remains to provide better accommodation at the Broomielaw.

The accommodation must ever remain very imperfect and inconvenient while the vessels are suffered to lie in the tideway and current of the river. Any attempt, therefore, to lengthen the present quays appears undeserving of attention; and the value of the ground which must be purchased for this purpose would also amount to no inconsiderable sum.

To obtain the most perfect species of accommodation, recourse must be had to a wet dock; and it remains to be considered where it is advisable, under all circumstances, to construct a dock of this sort.

It appears very evident that it ought not to be on the south side of the river; and, on the north side there is only to choose between cutting back into the adjacent building-ground, or taking the present bed of the river, where the ships now lie at the Broomielaw.

The plan of cutting into the building-ground has the advantages of being executed with less risk, and of placing the dock clear of the land floods; but there being no water to spare from a higher level, to supply the dock and lockage, the surface of the water in the dock cannot be raised higher than at the Broomielaw; the excavation, therefore, as well as the purchase of the ground, would be enormous.

To convert a portion of the present bed of the river into a wet dock appears to be the simplest and least expensive plan; this is rendered more advisable from the circumstance of having, without purchase, a sufficient space for a new channel to the southward. Upon a plan of the river, which was furnished me by Mr. Spreull, I have drawn in red the outlines of what I have here recommended to be done, which will afford nearly three times the accommodation of the present quays.

By a number of borings, which have been made under the direction of Mr. Spreull, it appears that at the distance of 17 feet, under the lowest part of the surface of the wharf at the Broomielaw, there is a stratum sufficiently compact to be water-proof, and that upon this there lies a bed of gravel and soft mud; if, upon further examination, it proves quite certain that this is the case, it will be advisable to excavate the gravel and soft mud by means of a dredging-machine, and upon the water-tight stratum to build two walls at such a distance from each other as, when completed, shall afford a quay of 50 feet in breadth. The space between these walls must be filled up with mud and gravel, which will be procured in excavating the bed of the river for the dock and the new channel to the southward. A part of the ground deposited between the walls must be worked into puddle so as to be perfectly water-tight from the bottom to the top; the walls, which form the sides of the quay, are proposed to be constructed of masonry laid without mortar. Around the space for the lock, at the bottom entrance into the wet docks, and likewise at the top, there must be coffer-dams, and the masonry must be laid in water-mortar. Adjacent to the entrance lock there is an excellent situation for a dry or graving dock, which is much wanted.

Previous to commencing any of the new works in the present bed of the viver, it will be necessary to form a part of the new channel.

I have no apprehension that this change will cause the floods to rise any higher than usual, because the course of the river will be made more direct than at present; and when the water rises to a certain height, it will flow over the quays in the same manner as it now does over the wharfs at the Broomielaw on the north, and the Green ground on the south side.

As more trials are necessary to prove with accuracy the qualities of the strata in the bed of the river, and as I have not yet made out any detailed plans and sections of the several works, I cannot pretend to give an accurate estimate of the expense which will attend forming the harbour here recommended; but, from the calculations which I have been enabled to make, it appears to amount to about 20,000*l.*

The urgency for this improvement is best known to those who are most connected with the shipping which frequent the Broomielaw; but it is evident that places of comparatively small importance have benefited greatly by turning their attention seriously to the improvement of their navigation and harbours; and others, from neglecting to attend to these material points, have insensibly lost advantages which are not easily regained.

THOS. TELFORD.

To the Right Hon. the Lord Provost and
Magistrates of the City of Glasgow.

No. 325.

Report and Plans by JOHN RENNIE, Esq., *of a Wet Dock in the Channel of the River Clyde; also of one in the Windmillcroft.*

No. 325.
Rennie, on a Wet Dock in the Channel of the River; and one in the Windmillcroft.

January 26, 1807.

MY LORD PROVOST,

IN consequence of a resolution of your Lordship, the magistrates, and town council of the city of Glasgow, directing Mr. Chamberlain Spreull to wait on me, when passing through Glasgow on my way to Edinburgh, and to take my opinion respecting the present mode of improving the River Clyde; the best plan of bringing up more tide, as well as my ideas respecting the advantages that a track-way or towing-path for horses, as far down the Clyde as the Renfrew Canal, would give to the trade. Mr. Spreull was also directed to consult me upon the most eligible method of giving additional berth-room for the vessels, or of forming a harbour at the Broomielaw.

These official resolutions were not communicated to me before the 29th of November last, when at Greenock; and I had then unfortunately made engagements at Edinburgh which could not be set aside, so as to enable me to spend above a day on these important matters. I arrived at Glasgow on the 1st of December; but the river was so swelled with the heavy rains that had before taken place that none of the works could be seen, and, of course, all examination of the river was impracticable. It cannot, therefore, be expected this Report should be so full and satisfactory as I trust it would otherwise have been, had I taken a proper view of the river; and, indeed, had I not been well acquainted with it before, I could have made no Report at all on the subject matter referred to me by your Lordship, the magistrates, and council.

In the month of October, 1798, I examined the River Clyde from the old bridge to near Dumbarton, and made particular observations respecting the manner in which the works for the improvement of the navigation were constructed; and, on the 22nd of August, 1799, I made a Report on the best mode of rendering the river fit to carry off the floods which so much annoyed the lower part of the city. These works have been since carried into execution, and, I am told, have effectually removed the inconveniences experienced from the floods or spates of the Clyde.

In the course of my examination of the river between the bridge of Glasgow and Renfrew, I observed many of the jetties projected awkwardly into the river, so as greatly to interrupt both the flowing of the river and tide; and others again were too short, which occasioned eddies and shoals; that the river, although deep in those places where the contractions were made, yet in general between them the channel was wide, the current languid, and the silt or alluvial matter with which the river is frequently charged, had subsided and formed sandbanks. In consequence of these observations, I advised Mr. Spreull to have a regular survey of the river taken, and all the jetties correctly laid down on a plan, the shoals, &c., &c., and said, if he would favour me with this plan, I would mark out where the jetties should be shortened, where lengthened, and where new ones should be established, so as to direct the channel in its proper course, with the least obstruction to the water the nature of the case would admit of. I also advised that low rubble walls should be built from jetty to jetty, to render the channel uniform, and to prevent the accumulation of shoals that I found had taken place between these jetties, and that the gravel and mud of which these shoals were composed should be taken out and deposited behind these walls, so as to make land, taking care that the walls should be kept low, and that the banks should gradually rise on each side, so that, whenever the river was at all swelled by rains, so as to flow beyond its usual limits, the water should be at liberty to rise on the slopes on each side, and thereby escape.

The plan I have mentioned occupied much time, and Mr. Spreull has very judiciously, as I understand, carried these improvements into execution, from which the best results have followed; but never having seen this plan until I was at Glasgow in December last, I had no opportunity of marking out distinctly where I thought the alterations could be done to the greatest advantage. I conclude, however, they have been done; and it gives me great satisfaction to learn, that the navigation has been so much improved in consequence thereof. Having therefore given the opinions I did in the year 1799, I cannot for a moment hesitate to advise, that a plan such as I have mentioned, should be continued; and that the best means of bringing up more tide to the Broomielaw, and improving the depth of water in the river, as well as lessening the effects of land-floods, opposite the city of Glasgow, is by the following up of this plan.

I do not correctly remember whether anything was said, when I was on my survey of the river, respecting a towing-path for horses. If, however, nothing was said, yet it was one object I had in view at the time I gave my opinion respecting the improvement of the river; and had I written a Report upon it, I should certainly have urged, as strongly as I could, the propriety of making a track-way for horses, from which many advantages must result. First, as the labour of horses is much cheaper, as well as more effectual than that of men, so much must, of course, be saved to the trade. Secondly. As it is more expeditious, ships of larger draft of water, which can only come up to Glasgow when the springs are nearly at their heights, would thereby often save nearly a fortnight in the making of their upward voyage, and as much in their downward voyage; for if they are once neaped in the channel, and the tides fall off, they must there remain until the springs return, or the owners must submit to the expense of lightening a part of their cargo to free them from the shoals; whereas, if they got during the springs, either up to the Broomielaw, or down to the deep water, all this would be saved, advantages so apparent, that little reasoning on my part is necessary to enforce the propriety of making a horse towing-path; indeed, I am rather surprised that it has not long ere this been carried into execution.

In regard to giving additional berth-room for vessels lying at the Broomielaw, the most simple and least expensive mode would be to extend the present quay wall further down the river, and to raise the whole sufficiently high, to be above the height of moderate floods. The present quay wall is only about 1120 feet in length, which is by much too short to afford convenient room for vessels to get to the quay to discharge their cargoes speedily; they often now lie in three or four rows abreast of each other, by which great inconvenience is experienced, as well as much detention in the discharging and loading of their cargoes; but, besides this, during floods, particularly at the breaking up of a frost, they are so crowded together, that much damage, as I am informed, frequently ensues, and always much tear and wear. Extending the quay wall, therefore, further down the river, would not obviate all these objections; by this plan, no doubt, further quay-room for the berthing of vessels would be obtained, and vessels would thereby be enabled to extend further downward; of course, they would not be so apt to sustain injury during floods as they now do, there being more room for the floods to pass off;

No. 325.
Rennie, on a Wet Dock in the Channel of the River; and one in the Windmillcroft.

but still considerable damage would often take place, although perhaps not quite to the extent it now does. The rising and falling of the tide are also inconvenient to vessels while lying alongside of a quay, by varying the height of their decks so much; whatever improvement therefore could be made in this way, would not give the advantages to the vessels frequenting the Port of Glasgow at the Broomielaw that its importance demands; and I have no hesitation in saying that this can only be done in a complete, effectual, and convenient manner, by means of a wet-dock. The question therefore is, Where can a wet-dock be most conveniently constructed?

If ground could be conveniently found on the city side of the Clyde, and out of the channel of the river, I would greatly prefer one being constructed on the solid ground, clear of the river, and out of the way of its floods; but unfortunately, the buildings on the city side are extended so far to the westward, near to the river, and on high ground, that nothing can be done to advantage in this way, unless at a very heavy expense, or unless it is made so far down the river as to be inconvenient for the city; and convenience is of such importance, that too much can scarcely be sacrificed to obtain it. I cannot illustrate this more strikingly than in the cases of the London and West India Docks; for although the latter will not cost half the former, and although their magnitude is much greater, yet such merchants as are at liberty from the restrictive clauses in the respective Acts of Parliament, crowd their vessels to the former, and avoid the latter whenever they can; I am persuaded, the owners of vessels trading to the Broomielaw, would prefer the present inconvenient situation, with all its disadvantages, to the using of a dock, however safe and convenient, if placed at any considerable distance from the city.

On examining the ground with all the attention of which I was able, two situations only appeared to me suitable to the purpose of a wet-dock. The one is, cutting off a part of the present wharf at the Broomielaw, and making a wet-dock partly on this, and partly out of the present channel of the river. The other is that of Windmillcroft, on the south side of the river, where there is a piece of ground clear of houses, just large enough to admit of a convenient wet dock, with suitable wharfs and warehouses.

The former being nearer to the city than the latter, in point of situation, has, no doubt, the preference, but in other respects, is inferior.

First, Because it will in some small degree obstruct the passing off of the floods, if carried as far to the south as I could wish it, to make a convenient width for a dock, which should be about 200 feet; but if made only 160 feet wide, there will be as much room left for the floods, nay something more, than there is at present, providing the quay-wall in the river be not built higher than the present at the Broomielaw, which I propose it shall not exceed.

Secondly, As the quay on the south side cannot well be made higher than the present quay at the Broomielaw, that the floods may have free room to escape; in times of great floods this quay will therefore be covered with water, and of course some small inconvenience will arise, but this will not be considerable.

Thirdly, As this quay-wall cannot be made wider with convenience than 50 feet, no warehouses can be built with propriety upon it. The side next the city is also narrow, in some places not more than 90 feet, but averaging about 100 feet. This space is little more than what will be wanted for a wharf; and as a part is covered with good houses, warehouses could not be built in front of them. It is true, 900 feet in length has no buildings of any value upon it, and it is possible this might be purchased for that purpose, if judged sufficient, and advisable to do so; or if a dock would answer the desired purpose without warehouses, the object could readily be accomplished. These are the inconveniences attending this situation, which do not, I confess, appear to me very serious; but it is my duty to state them as they are, and your Lordship, the magistrates, and council will judge accordingly.

The present extent of quay at the Broomielaw, as I have stated before, is about 1120 feet, and vessels now lie three or four rows deep against it. Nothing less than double the extent of quay would therefore conveniently suit the purpose of the present trade, and as by the improvements of the Clyde, which I have no doubt will continue for years to come, more vessels will come up to Glasgow than have hitherto done, independent of those that will become necessary as the city increases; provision should also be made for them. I am therefore of opinion, a dock of about 1350 feet in length, by 160 feet in width, will not be more than what ought to be made; this I have represented on the plan. It has two locks, one for the vessels that come from below, 24 feet wide and 108 feet long; the other above, to communicate with the river for smaller craft, which may go up as high as the depth of water will admit.

There is also a dry-dock proposed to be made at its north-west end, for the repairing of vessels; this, however, may be done at present or stand over to a future period, as shall be judged advisable.

The expense of this dock, the locks, paving the wharfs, the swivel bridges which should be made across the locks, to communicate with the south wharf, if done in a proper and substantial manner, but exclusive of the dry-dock, amounts, by my estimate, to 38,168*l*. I have no hesitation in saying, that if done in a slight and imperfect manner, it may cost less; but I do not think that public works should be executed in this way; repairs are not only very inconvenient, but very expensive; and I should not like to be concerned in any work liable to fail by every heavy flood, or by every severe storm that happens, as many works in this kingdom have lately done.

The other situation for a dock is on Windmillcroft, on the south side of the Clyde. Here the ground is large enough for anything that can be wanted; a dock 1170 feet long and 200 feet wide can be constructed here with convenience; the projected street on the north side will form an excellent public quay; and one of 80 feet wide, with a row of warehouses 50 feet wide, may be built on the south side. Access to both the dock and warehouses is most convenient to the public wharf by Clyde-street; and to that where the warehouses are proposed to be, by the Paisley Road. The wharf on this side may be entirely confined to shipping and unloading cargoes, and such articles as are to be deposited in warehouses for home consumption; those that are not to be carried away by water may be taken from the back of the warehouses. In short, no piece of ground could well be found more convenient in point of loading and discharging vessels than this is. A communication can be formed with the river by a cut similar to that represented on the plan, and a swing or drawbridge being placed on it, will continue the line of Clyde-street.

The ground is high enough to be out of the reach of ordinary floods, and, indeed, of extreme floods, if it shall be judged advisable to make the quays so high.

It will be filled with water from the river by the tide through the lock, as well as the other will, as the tide is always as high (except in time of floods) as the water just above the bridge; no difficulty

APPENDIX C.

GLASGOW.

No. 325.
Rennie, on a Wet Dock in the Channel of the River; and one in the Windmillcroft.

will, therefore, arise on this account, as it is entirely out of the channel of the river; this may be improved so as to carry off the floods from above, to any extent that future experience shall render necessary. Vessels can be worked at all times here, on both sides of the dock, as it is something larger than the other; this covering 26,000 square yards with water, while the other covers only 23,730 square yards. The expense of a dock here is, as by my estimate, 33,268*l*., which is less than the former by 4900*l*. But here it must be observed, that the land, namely, Windmillcroft, is of considerable value; and that value is to be added to this sum, whatever it may be. The purchase of some additional land at the Broomielaw, to widen the wharf, and for warehouses, if such should be determined on, falls also to be added to the other scheme; these can be better done at Glasgow than I can here, and therefore have not been included in my calculation. If this latter plan is adopted, a dry-dock may be made at the lower end of the Broomielaw, as shown in the plan. Whether this dry-dock be made from a wet-dock at the Broomielaw, or from this, the difference of expense will not be considerable; in the former case I have estimated it at 2532*l*., and I do not think it will cost more.

Under all the circumstances of the case, distance excepted, I would greatly prefer the making of a wet-dock in Windmillcroft; but as the communication with it must be across the New Bridge, where there is a toll to pay, and an extra distance of about 650 yards, which is more than a quarter of a mile, I own I am somewhat staggered. This, however, I must leave to those concerned in the trade, who are doubtless better judges than I; but whichever plan be adopted, I am persuaded it may be carried into execution without injury to the navigation of the Clyde; that at the Broomielaw, however, will be more liable to accidents while in execution than the other, and therefore the expense may differ more from the estimated sum than it.

I have, &c.,
JOHN RENNIE

The Right Hon. the Lord Provost, Magistrates, and
Town Council of the City of Glasgow.

No. 326.

Remarks by J. RENNIE, Esq., *with regard to the proposed Docks.*

No. 326.
Remarks by Mr. Rennie, on the Site of the proposed Docks.

SIR, *London, June* 15, 1807.

ON my return to town last night I found your letter of the 10th.

The variety of queries and other observations which have been sent along with it, will require more time to be answered in a detailed Report than either the present state of my engagements or health will admit. I must, therefore, beg the favour of the Lord Provost and magistrates to accept of what is said in this letter as a general answer to the whole, until I am able to enter more into detail.

I have no hesitation in giving it as my decided opinion, that if ground could be found in a convenient situation, it would be better to make a wet-dock out of the river than in it; because it will not only afford more room and convenience for wharfs and warehouses, &c., than a dock made at the Broomielaw, partly in and partly out of the river, the wharf next the river being no higher than the present quay at the Broomielaw, but because it will be more easily made, not having the river to combat, and will occasion less interruption in the trade while being made, because the section of the river will be as it now is, or extended if judged necessary; this opinion I have explicitly given in my Report of the 26th of January last, and only now repeat it for the sake of showing that I have never held a different one. The words are these:—"If ground could be conveniently found on the city side of the Clyde, and out of the channel of the river, I would greatly prefer one being constructed on the solid ground clear of the river, and out of the way of its floods; but, unfortunately, the buildings on the city side are extended so far to the westward, near to the river and on high ground, that nothing can be done to advantage in this way unless at a very heavy expense, or unless it is made so far down the river as to be inconvenient for the city, and convenience is of such importance that too much can scarcely be sacrificed to obtain it."

Holding the above opinion, I mentioned Windmillcroft, on the west side, as the most suitable, under all the circumstances, that has come to my knowledge; the distance not appearing to me so great as to occasion any very weighty objection against it; the difference of distance between this and a dock at the Broomielaw being about 650 yards. As, however, the situation at the Broomielaw has been chosen by the Lord Provost and magistrates, in preference to Windmillcroft, I apprehend this 650 yards of difference in distance, together with the toll to be paid at the New Bridge, has occasioned the preference. The distance, if at Windmillcroft, cannot be lessened, but the toll at the New Bridge may, I apprehend, be commuted. A situation for a wet-dock is now proposed, which did not appear to me, when I examined the ground, suitable; but the weather was so bad, and the time I remained at Glasgow so short, that I had not an opportunity of viewing it in the way I could have wished. But I will admit, for the sake of argument, that a wet-dock may be made near the lower end of that proposed by me at the Broomielaw; this wet-dock will be about 230 yards nearer to the city than that on Windmillcroft. In the above place there is not only abundance of room for a wet-dock suitable to the present, but to the growing trade of the city, and also for wharfs and warehouses. At the other, from the plan proposed, there does not seem to be enough, unless the present quay at the Broomielaw be taken as a part; and I am persuaded, that if a complete and convenient dock were to be constructed, the Broomielaw would be deserted. The dock should therefore be made large enough for the whole. If this should prove to be the fact, I cannot think the extra distance of 230 yards will give a preference against Windmillcroft, unless the other should be equally large and convenient.

A dock at Windmillcroft will cover about $5\frac{1}{2}$ acres with water; the other, about $3\frac{1}{2}$. The first will have 2720 feet of quay room; the second, 2120 feet. The former have broad wharfs and easy access, room for warehouses, &c. The latter will, in my opinion, be by no means adequate to the trade; unless, therefore, the ground will admit of its being enlarged, and the dock made at a moderate expense, I should prefer the former; but if all the requisites can be had here, I would prefer the latter.

As to the alarm respecting a dock at the Broomielaw (as proposed by me) damming up the river, so as to inundate the lower part of the city more than at present, I have no fears on that head. The new channel will be of larger capacity than the present. The land on the west side forms a dam

Appendix C.

Glasgow.

No. 326.
Remarks by Mr. Rennie, on the Site of the proposed Docks.

higher than the ordinary state of the river, across four arches and part of the fifth. The now proposed dock will form a similar dam (but higher) across two arches and part of a third. The area of the now proposed channel will be in every part of its course, and at every height of a flood, according to the sections that have been furnished me, greater than the present. A greater section will certainly pass a greater quantity of water in the same time than a lesser. Eddies must be formed in both cases, and why the eddies arising from the one should be so much more tremendous than the other I cannot readily see.

If vessels are ever carried over the quay of the now proposed dock, the floods must be so high as to float them over it; but this is not like a sea that the waves will carry them over the walls: such floods are not likely to happen, at least, according to my information. But, admitting this to be the fact, *i. e.* the floods to rise so high as to float a vessel over it, the velocity of the water across the dock will be far short of what it will be in the main channel, and therefore will not require very strong tackle to hold the vessels.

No doubt it is more hazardous to make a dock in a river than out of it; but allowance has been made for the hazard in the estimate. There does not, however, appear to me any very serious difficulty here. I have made wet-docks and other works in much more difficult situations; and if the plan is to be carried into execution, I confess I should not feel much uneasiness about its success. On the whole, there appears nothing in any of the plans or arguments that have been laid before me, that in any respect has changed my mind on the subject, or that I have not already foreseen and considered. The dock may be slanted away a little more at the top, and pushed ten or twelve feet more into the land; this, I think, will remove all doubts.

I am, &c.,

James Reddie, Esq., Glasgow. John Rennie.

No. 327.

Report by J. Rennie, Esq., *respecting Improvements in the River Clyde.*

No. 327.
Rennie, on the Improvements in the River Clyde.

My Lord Provost and Gentlemen, *London, Dec.* 24, 1807.

In company with your chamberlain, on the 5th of November last, I examined the River Clyde, from Dumbarton Castle to the Wooden Bridge at the city of Glasgow. The river at this time was very much flooded, and as there had been a great deal of blowing weather for several days previous, there was much greater depth in the channel than is usual at low water. Of course, the soundings which are stated in this Report are much greater than they ought; but they will afford a tolerable criterion of the comparative depths of water at the different parts of the river:—

	Supposed Soundings if it had been dead low water, but on the supposition of the river being in a flooded state.		Real Soundings.	
	Ft.	In.	Ft.	In.
Between Dumbarton Castle and the lower perch on the Long Dyke, the least depth of water in the channel was about	9	0	10½	0
Between thence and the east end of the Long Dyke the least depth was .	9½	0	11	0
But in general the depths were more than double this.				
At the third perch east of the Long Dyke the depth was about . .	10½	0	12	0
The channel at this place is very crooked and difficult of navigation. It is scarcely possible that the vessels can keep it, especially in adverse winds; and then they are not only delayed in their voyage, but exposed to some hazard.				
Opposite Frisky House the least depth was	7	6	9	0
Opposite entrance of Forth and Clyde Canal in Bowling Bay . .	5	0	6	6
Near the entrance of the lock a sankbank is generally thrown up, which greatly obstructs the passage, and the Company have been at the expense of building a rubble wall from the lock along the north shore of the river, for some distance upwards, in order to lead the current more directly on the wings of the entrance lock, so as to deepen the water. This, however, has not answered the purpose; to effect which a more essential alteration is requisite.				
Opposite Erskine House	7½	0	9	0
At Jetty No. 3, on the north side of the river	9	3	11	0
,, 7	9	3	11	0
,, 8	7	3	9	0
Near this place there is a large shoal, on which there is much less water.				
At Rashylee Dyke	6	3	8	0
Quarry Quay	7	6	9	6
At Jetty No. 9	8	6	10	6
, 10	8	0	10	0
,, 11	8	0	10	0
,, 12	7	3	9	6
The tide stood here at 2 feet 3 inches on an old gauge, which had been established in the early commencement of these works.				
At Jetty No. 14	3	9	6	0
,, 15	7	3	9	6
,, 16	9	6	11	9
,, 17	10	9	13	0
,, 19	10	9	13	0

No. 327.
Rennie, on the Improvements in the River Clyde.

—	Supposed Soundings.		Real Soundings.	
	Ft.	In.	Ft.	In.
At Jetty No. 20	7	9	10	0
,, 24	8	0	10	6
Opposite the mouth of the River Cart	6	0	8	6
At Jetty No. 26	6	0	8	6
,, 27	8	0	10	6
,, 28	8	0	10	6
,, 29	8	0	10	6
,, 30	6	3	10	6
,, 31	6	3	10	6
,, 32	6	6	9	0
,, 33	7	6	10	0
,, 34	7	9	10	3
,, 35	8	6	11	0
,, 39	8	0	11	0
,, 40	7	6	10	0
,, 41	6	6	9	0
At Ferry Quay	7	0	9	6
At Jetty No. 42	7	6	10	0
,, 43	8	0	10	6
,, 44	8	0	10	6
,, 45	7	6	10	0
,, 46	9	6	12	0
,, 47	3	6	11	0
,, 48	8	0	10	6
At Scotstown Jetty	7	0	9	6
At Jetty No. 51	7	0	9	6
,, 52	7	6	10	0
,, 63	7	6	10	0
,, 54	7	0	9	6
,, 55	9	0	11	6
,, 56	10	6	12	6
,, 57	6	6	9	0
,, 58	7	6	10	0
,, 59	9	0	11	6
,, 60	8	6	11	0
,, 61	9	0	11	6
,, 62	8	6	11	0
,, 63	10	6	13	0
,, 64	10	0	12	6
,, 65	8	9	11	3
,, 66	8	0	10	6
,, 67	7	9	10	3
,, 68	8	0	10	6
This last sounding was a little below the work-yard belonging to the trustees of the River Clyde; and here is a gauge on which the water stood at 8 feet 7 inches. I took a sounding opposite this gauge, and, after deducting 2 feet 6 inches, the height the tides were supposed to have risen, it left 8 feet 6 inches.				
At Jetty No. 69	8	6	10	6
,, 70	7	6	10	0
,, 71	7	6	10	0
,, 72	7	0	9	6
,, 73	6	6	9	0
,, 74	7	3	9	9
From 74 to 79 there was generally about	8	6	11	0
At Jetty No. 80	7	3	9	9
,, 81	7	0	9	6
,, 83	7	9	10	9
At this place the tide had risen, as I was informed, about 3 feet.				
At Jetty No. 84	8	4	11	0
,, 85	7	6	10	6
At Kelvin mouth	6	0	9	0
At the Ferry above	6	9	9	9
At Jetty on the north side, No. 87	9	0	12	0
,, No. 88	6	9	9	9
,, 89	8	0	11	0
,, 90, and 91, deep water.				
,, 92	9	6	12	6
,, 93	9	3	12	6
Tide had risen here, as I was informed, about 3 feet 3 inches.				
At Jetty No. 94	6	6	9	9
,, 95	9	3	12	6
,, 96	9	0	12	4
,, 97	7	9	11	0
,, 98	6	9	10	0
,, 99	8	0	11	6
,, 100 to 103	7	9	11	0
,, 104	6	0	9	6
Tide had risen here 3 feet.				

APPENDIX C.

GLASGOW.

No. 327.
Rennie, on the Improvements in the River Clyde.

—	Supposed Soundings.		Real Soundings.	
	Ft.	In.	Ft.	In.
At Jetty No. 105	6	0	9	6
,, 106	7	6	11	6
,, 107	7	0	10	6
,, 108	7	6	11	0
,, 109	7	0	10	6
,, 110	7	9	11	3
,, 111 and 112	6	6	10	6
Tide had risen here about 4 feet.				
At Jetty No. 113	8	4	12	4
,, 114	8	0	12	0
,, 115	7	6	12	0
Tide had risen here about 4 feet 6.				
At the lower end of the Broomielaw	6	0	10	6

At this time the tide had risen four feet six on the gauge mark at the Broomielaw, which added to the above sounding, makes ten feet six inches, the depth I found. At the same time there were three feet four inches on the top of the stone weir below the new bridge, and under the arch there were from seven to eight and a half feet.

These gauges, to which I have referred, do not seem to denote the depth of water at any one place, and I cannot ascertain upon what principle they have been established. They answer, however, as comparative marks on taking soundings, but do not denote the real depth.

The soundings from the new bridge to the timber bridge were taken at regular distances, and at a time when the water stood at the height of four feet six inches on the gauge mark at the Broomielaw, and when there was no sensible fall at the weir below the new bridge:—

	Ft.	In.
Just above bridge	5	0
Second sounding	4	6
Third ,,	4	6
Fourth ,,	4	2
Fifth ,,	3	3
Sixth ,,	3	6
Seventh ,,	3	0
Eighth ,,	3	3
Ninth ,,	3	9
Tenth ,,	3	9
Under arch of old bridge	3	9
,, ,,	6	9
,, ,,	4	0
Under arch of old bridge	3	9
,, ,,	3	6
,, ,,	3	10
,, ,,	4	0
,, ,,	4	0
,, ,,	4	0
,, ,,	4	6
,, ,,	5	6
,, ,,	6	0
,, ,,	4	6
,, ,,	3	6
,, ,,	3	9
Under the wooden bridge	3	6

The soundings between Dumbarton Castle and the head of the quay at the Broomielaw were taken in the middle of the channel in which the vessels navigate, and those I have noted were at the end of the jetties on the opposite sides of the river, wherever it could be done. When there was not a jetty on the south side of the river, the sounding was always taken near the end of that on the north side. Between the jetties I generally found about a foot less water than at the ends of them; but I made frequent trials of the depth out of the channel, and there I found the water much shallower. The channel is very narrow, and in many places crooked. Vessels, therefore, with adverse winds, or when passing each other, frequently get aground; so that, in the present state of the river, it is by no means a safe and good navigation. In fact, the principle on which the improvements are made is very deficient, and unless another mode be adopted it will be impossible to render the navigation complete, according to the spirit and directions of the Act of Parliament.

When the channel of a river is partially contracted, such as the Clyde originally was by Mr. Golborne's plan, and now in a great part is, the water will no doubt become deeper where these contractions are; but what is removed by the current, or by dredging from the narrow places, is lodged in the wider parts, where the current is more languid, and thus sand banks or shoals are formed. These sandbanks may be in part lessened by means of dredging; but this is only a partial measure, for they will return in a short time after they are removed. I have every reason to believe that great attention has been paid to the river, and the shoals so formed have been frequently removed, but they always return to a considerable extent; and I found, I may almost say universally, that there was from nine inches to a foot of less water between the jetties than opposite their ends; and this will always be the case in a greater or less degree while the improvement of the navigation depends upon jetties so formed. No complete or regular depth of water can ever be expected unless the river is regularly contracted according to the quantity of fresh and tide water that is to pass through it; and this has been satisfactorily proved by the walls that have been built between some of the jetties, as recommended by me in the year 1798. Wherever these walls have been built, the channel of the river is of a uniform depth in the middle; and although it is not so deep, nor ever can be, in the nature of things, close and adjoining to these side walls as in the middle, yet the difference is less than it is where there are no such walls. These results accord so well with what I expected, that I have no hesitation in recommending their adoption throughout the whole length of the river over which the power of the Act extends; and indeed my opinion is, that, at some future period, another Act should be obtained to extend them much farther downward.

Besides building side walls as I have mentioned, the jetties in some places should be shortened, in other places lengthened, so that the walls, by being built from jetty to jetty, may give as regular a curve to the channel of the river as can conveniently be done, and bring it to such a section as the river and tides may be able to maintain of the requisite depth for a complete navigation, such as the nature of the case will admit.

I have laid down, on a large plan of the river in the possession of the Chamberlain, the various

APPENDIX C.

GLASGOW.

No. 327.
Rennie, on the Improvements in the River Clyde.

alterations which appear to me advisable, and I will state in this Report the width I propose the river to be in various places, viz. :—

	Feet.
At the west end of the Long Dyke	696
At one quarter of a mile east of do.	664
Opposite Milton Island	632
Upper end of Long Dyke	600
At the Perch east of the Black Perch	563
Opposite Dunglass Point	536

The river to be reduced to these widths by a rubble wall, built on the north side, from Dunglass Castle to Milton Island, and from thence to a point marked on the plan, east of Dumbarton Castle.

The long dyke to be straightened and extended by a regular curve to the westward of the Ferry quay, on the south side, and all these walls to be about half flood high.

	Feet.
Between Dunglass and Frisky House	504
West end of Bowling Bay	472
Opposite the entrance of the Forth and Clyde Canal	440

I do not propose that there should be any rubble wall on the north side, between Dunglass Castle and the Forth and Clyde Canal, but that on the south side there should be one from the east end of the Long Dyke to the West Ferry House. By this plan the whole of Bowling Bay will be left open for the use of such vessels as may have occasion to anchor there waiting for the tide, or for those trading to or on the Forth and Clyde Canal. The wall on the south side will direct the freshes and tides towards the entrance of the canal, and will give deeper water there, as well as in Bowling Bay. Vessels, therefore, entering the canal will not experience the frequent interruptions they now do by the accumulation of sand-banks, but this cannot be entirely removed, unless some alteration is made on the entrance lock.

I propose the river to be contracted to the width of 425 feet opposite Glenbuck.

	Feet.
About one quarter of a mile farther east	410
Opposite the Jetty No. 2, on the north side	395
,, ,, 5,	380
,, ,, 7,	370
,, ,, 8,	360
Opposite North Barr House	350
Near the wharf where the punts are loaded with stone from the quarry to make the rubble walls	340
At Jetty No. 9,	330
,, 10,	322
,, 11,	315
,, 14,	308
,, 17,	301
,, 20,	294
,, 22,	287
,, 24,	280

Just above this jetty the river Cart enters the Clyde. The jetty on the west side of this entrance stands in a direction quite across the Clyde. Instead, therefore, of allowing the water of the Cart to enter the Clyde in an easy manner and fall into its stream, it strikes quite across it, and occasions a kind of eddy. If it were bent round in a westerly direction, the water of this river would fall easily into the Clyde. If this jetty were extended up to Collin's Island, it would still join the Clyde in an easier manner.

	Feet.
At Jetty No. 25, just above the junction of the Cart with the Clyde, the width should be	240
Near Jetty No. 27,	237
West of ,, 29,	235
,, ,, 33,	232
At Renfrew Ferry,	230
At Jetty No. 40,	226
,, 44,	222
,, 48,	
Between . 52 and 53,	
At Jetty . 56,	
Between . 58 and 59,	
,, . 62 and 63,	
,, . 65 and 66,	200
,, . 68 and 69,	196
,, . 72 and 73,	192
77,	178
Between . 81 and 82,	184
At Jetty . 85,	180

Just above the jetty No. 85, the River Kelvin joins the Clyde, and here it will be proper that the jetty be so placed as to lead the water of the Kelvin into the Clyde in the same manner as is proposed for the Cart.

	Feet.
Just above Ferry Quay, at jetty No. 86, the river should be contracted to	150
Between Nos. 80 and 91	147½
Ditto 94 and 95	145
98	142
102	140
106	137½
110	135½

APPENDIX C.

GLASGOW.

No. 327.
Rennie, on the Improvements in the River Clyde.

A short distance above the jetty there is a wharf on the north side, which projects awkwardly into the river; this should be cut off and the sweep made more regular.

It happens very unfortunately that the river near this place has been laid out in a very improper manner. The channel was here originally very wide, and a fine opportunity was afforded of straightening it; but instead of this, it has been laid out with a great bend, and, unfortunately, not only the jetties here have all been completed but their ends have been joined by rubble walls, and all the space behind these walls and between the jetties have been filled up, so that to alter this bad place now would be attended with a heavy expense; and indeed I have my doubts whether it could be done at all, unless fresh Parliamentary powers were obtained, or the landowners should give their consent to it. Under these circumstances I am doubtful whether it would be advisable to alter it at present.

From the above mentioned bend to the Broomielaw the river is tolerably regular in its depth, and a considerable part of the rubble walls has been completed, therefore little more is wanted to complete this part of the navigation, except a new weir at the bridge, and a wet dock, either at the Broomielaw or on the north side of the river below it. The latter will form subject for another report. I need scarcely observe that there should be a towing-path for horses on the bank as far as it can be made, as recommended in my former Report.

It has been said that the dam or weir across the river by the new bridge prevents the navigation to Rutherglen, and if this dam were removed, barges of considerable burthen would have free passage up the river. It, is, therefore, a favourite object with the inhabitants of Rutherglen, the removal of this dam, and I am told that legal measures are to be taken for the purpose of obliging the trustees to remove the dam, or to make an opening in it so as to admit of the free passage for barges upwards.

On referring to the original plan of the new bridge at Glasgow, deposited in the Chamberlain's office, it appears that the top of the weir is not higher than the original bottom of the river, and that, by the soundings I took on the 5th November last, there is a greater depth of water on the top of the dam when the tide stood at the 4 feet 6 inch gauge-mark on the quay at the Broomielaw than is in the river above, as will be evident on inspecting the soundings stated in this report. It is not an easy matter to say whether some mud and silt may have settled since the bridge was built and the weir erected, but the fact may in some measure be gathered from this, namely, that except in one part at the middle of the great arch of the old bridge there is less water than even on the dam, and the same shallow depth extends quite to the wooden bridge, except in one place below said wooden bridge, where a hole was made by the water after the fall of the stone bridge. The soundings from the wooden bridge to the blind burn are also of less depth than on the weir, so that there is little reason to believe that the river so far has been affected by the weir in question.

Were an opening to be made in the weir, as proposed, for the navigation upwards, no great advantage would arise. It is true that the current of the river would be drawn to this opening, and for a short distance upward some depth would be acquired by this current scouring the bottom, and some less obstruction would be given to the influx of the tide; but this would extend but a very short distance, and would by no means compensate for the difference of depth between the top of the weir and the river upwards.

If the weir were to be lowered, considerable advantage would be gained in carrying the floods more speedily off during the absence of the tide, and this also would deepen the bottom of the channel upwards; but such an improvement ought not to be given as a right, but as a boon to the public. I am decidedly of opinion it would be of greater advantage in carrying away the flood-water speedily than any other work that could be devised, unless the water-way of the old stone bridge were to be enlarged, which is less than the water-way of the new bridge in its present state. The great obstruction to the flood at this time arises more from the want of capacity in the bridges, particularly the old, than from anything else since the ground below the new bridge was lowered, for whenever the river rises to any considerable height, the springs of the arches being so low, the space or water-way is greatly contracted; and let the width of channel be what it may, the water has not sufficient force to preserve it unless it could pass with greater rapidity through the arches of the bridge. This appears evident from the mud or silt settling on the surface of the south bank of the river that has been taken away; that the bank is gradually rising, and in time will form a more formidable obstruction to the carrying away the floods than is generally imagined.

In all the calculations that have hitherto been made respecting the water-way of the new bridge, it does not appear that any one has made allowance for the oblique direction of the bridge to the current of the river. Had it been placed at right angles to the stream of the river, and had the river been straight both above and below it, the whole capacity of the arches might then have fairly been taken; but, the fact is, the bridge stands on a bend of the river, and the current of water strikes the piers obliquely and occasions eddies, and thereby obstructs the passage of the water through it; and when to this is added the space occupied by the great number of vessels lying alongside of the quay at the Broomielaw, it will be found that, if even the wet dock had been constructed as proposed, the floods would have passed off more freely than they now do. But if the dock is removed farther down the river as is proposed by the new plan, and the weir lowered, the capacity of the river to carry off the floods will be greatly increased indeed, independent of the improvements below, which will admit of a much freer passage not only for the tides upwards, but for carrying away the floods more rapidly. If the weir is lowered one foot or eighteen inches, the whole bottom of the river up to the old bridge, and even above it, will be scoured out and lowered; and I think this alteration may be made without endangering the foundations of the new bridge. The expense of this new weir will be considerable; still I think it would be policy to combine it with the plan for a wet dock, and then I apprehend every possible objection, in so far as the floods are concerned, will be removed, and I trust the objections of the coal-masters will be found of less importance.

I am, &c.,
JOHN RENNIE.

The Right Hon. the Lord Provost and
Magistrates of the City of Glasgow.

No. 328.

Report by JOHN RENNIE, Esq., *on Improvements at the Brocmielaw.*

No. 328.
Rennie, Improvements at the Broomielaw.

MY LORD PROVOST, *February* 3, 1809.

THE plans I had the honour to lay before your Lordship for the increase of quay room, and for the accommodation of vessels navigating the Clyde to the Broomielaw, and the reports on and estimates of the expense of performing the same, dated the 26th of January, and 26th of December, 1807, appearing to be more expensive than it has been thought funds could be conveniently raised to accomplish, I have, by your Lodship's desire, re-considered the subject, and I shall now propose a much less expensive plan, which, although far inferior in point of accommodation, may perhaps, under all the circumstances of the case, meet, in a certain degree, the wants of the trade, and serve to quiet the minds of those who, from the want of due consideration of the advantages to be derived, and from fears of a possible injury, have been induced to oppose the former plans.

The plan I have to propose is, to leave the river at the Broomielaw, with its wharf and quay, as it now is (except in so far as it may be judged advisable to extend the quay downward, and perhaps this may be done with advantage to York-street, which is about 450 feet below the present quay, and which will, no doubt, add much to the accommodation of the trade, but much short of what is required), and to make an excavation on the south side of the river, as represented on the plan, to be open at the lower end, and to extend upwards to within 240 feet of the new bridge, and to have a quay wall of ashlar built on its south side 1150 feet long, and 60 feet distant from the street in front of Clyde-buildings at the upper end, and 30 feet at the lower end; but, owing to the height of the street, it will be requisite that this quay should be about 3 feet higher above the surface of the water than the present quay at the Broomielaw, from which some inconvenience will arise in the ordinary state of the river; but when the river is swelled by floods, it will be found very useful, and can be used when that at the Broomielaw cannot. From the lower end of this ashlar quay wall to the junction of the new cut, with the stone dyke which was built for a towing path, I propose the bank to be sloped, and its foot guarded by rubble.

The cut should not be less than 160 feet wide, and guarded at its upper end by a wall of rubble stone, formed like a breakwater or overfall, to allow the water in floods to pass freely over it. The north side to be done also with a rubble wall similar to those on the Clyde below.

A dock of the sort I have described will, in no respect, obstruct the floods of the river from passing off, as no part of the works is intended to be raised higher than the present surface of the ground; but will, on the contrary, rather facilitate their discharge. Vessels will, in this place, ride with more safety in floods than they can at the Broomilaw, not only because the streagth of the current is on the opposite side, but because the solid ground and rubble-wall at its head, will weaken the force of the floods. But these advantages cannot be gained without some disadvantages; for, as no current (except in times of flood) will pass through this tide dock (as I shall name it), the mud of the river will settle in the still water; and, therefore, unless it is frequently dredged, it will, in time, become so shallow as to be unfit for use.

It is not possible for me to say what the expense of dredging will amount to annually, but I would guess that it may be done for about 150*l.*

Should it be determined at any future period to make a wet dock at the Broomielaw, as formerly proposed, this tide dock will not at all interfere with that scheme; but will, on the contrary, rather facilitate the work, by affording a quay for the use of the shipping, while it is going on, and by its excavation and walls on the south side, forming a part of the new channel into which the river must then be turned; so that, although the whole will ultimately cost more money than the execution of the wet dock at the Broomielaw would have done had this work never been executed, yet I am inclined to think that the immediate accommodation that will be afforded to the shipping by this plan, and the future, while the other is going forward, will, on the whole, render this a much more advantageous plan than may at first sight appear.

I have, &c.,
JOHN RANNIE.

The Right Hon. the Lord Provost of Glasgow.

Estimate of the proposed Tide Dock and Wharf on the South side of the River Clyde, in front of Clyde Buildings.

	£.	s.	d.
To 150,000 cubic yards of excavation, 1*s.*	7500	0	0
Puddling round the walls	90	12	4
1150 running feet of plank for the toe of the quay wall	172	10	0
6128 cubic yards of ashlar quay, at 17*s.*	5208	16	0
1150 running feet of coping extra, at 1*s.*	57	10	0
4100 cubic yards of dry rubble wall at upper end and north side of dock, at 7*s.*	1435	0	0
908 cubic yards of rubble footing at south side, at 5*s.*	227	0	0
5750 square yards of paving on the quay, at 2*s.*	575	0	0
Mooring-posts	150	0	0
Steam-engine, dams, &c.	2500	0	0
Contingencies	3583	11	8
	£21,500	0	0

No. 329.

Specification by J. RENNIE, Esq., *for the New Front or Quay Wall, proposed to be erected on the River Clyde, at the Broomielaw.*

London, November 13, 1809.

No. 329.
Rennie's Specification for the new Front or Quay Wall, at the Broomielaw.

First. The digging for the foundation of the quay wall, with the piling and planking under it, the making and forming the cofferdam, the pumping of the water, and the filling behind the wall, may either be contracted for separate, from the masonry or with it, as the trustees of the Clyde Navigation shall judge the offerers for the work adequate to the undertaking.

APPENDIX C.

GLASGOW.

No. 329.
Rennie's Specification for the new Front or Quay Wall, at the Broomielaw.

Second. The foundations are to be done in the following manner, namely: a row of sheeting piles to be driven in the direction of a tangent to the wall at its toe; these piles to be 8 or 10 feet in length, according as the nature of the ground may require, and 6 inches thick; each pile is to have a groove in it, and there is to be a dowel, about 4 inches broad, mortised into the side of the pile next to this, to keep it in its proper direction. When these piles shall have been all driven as close together as they can be, they are to be straightened at the top, and on their inside is to be fitted a piece of timber 12 inches deep by 8 inches thick, to which sill the piles are to be spiked. At the back part of the foundation another sill is to be laid flatways, 12 inches broad by 8 inches thick, and a similar sill at the extremity of the counterfort. These, the last-mentioned sills, are to be solidly bedded on the ground, and their upper surface in the direction of the radius of the wall; between them gravel is to be puddled, and when the gravel and sills are all in a straight direction, the whole, including the bead of the sheeting piles, is to be covered with planking across, and spiked to the sills, on which the foundation of the masoury is to be laid. The planking need only extend the width of the wall, except where the counterforts are, and the sills at the extremity of the counterforts are to be of the length of the said counterforts only.

The wall is to be puddled behind with gravel, and the spauls, afterward mentioned, to be thrown behind the said puddle.

Third. The new quay wall is proposed to extend about 900 feet in length westward from the present quay at the Broomielaw, conformable to a line laid down on a plan of the premises, and to which this specification refers; and its shape, dimensions, and mode of execution, are to be according to the following description:—

The height of the wall to be, from its toe to the top of the coping, 18 feet, and to have a curved batter in the vertical direction, the radius of which curve in the face is to be 50 feet, and its centre in a horizontal line with the top of the coping, at which place it is to be 4 feet thick; and, if the back is drawn to a radius of 75 feet, it will be about 5 feet thick at the base; this wall is to have counterforts behind it, 18 feet asunder, each counterfort to be 4 feet thick by 5 feet broad from the wall.

Fourth. The whole of the above wall and counterforts are to be built with ashlar, the joints of which are to be laid in the direction of the radius of the curved batter of the face, and header and stretcher alternately; the stretcher to be, on the average, 4 feet 6 inches long, but none to be shorter than 3 feet, nor narrower, on the average, than 2 feet, but no stone narrower than 1 foot 6 inches. The headers are not to be narrower, on the average, than 2 feet 6 inches, and none are to be used, less in breadth than 2 feet. The length of the headers is to be such that, when laid opposite to the stretcher, they shall be equal to the thickness of the wall; but every third header, from the fourth course upwards, is to go through the wall. None of the courses are to be less than 10 inches thick in the face, but they may be as much thicker as the quarries will produce; being radiated, they will of course be thicker at the further side of the wall. Each course is to be carried the same thickness the whole length of the wall, and no joint is to overlap another less than 10 inches. Great care must be taken in choosing the largest stones to connect the wall and counterforts in the like manner as the other parts of the wall are. The coping stones are not to be less than 4 feet long by 15 inches thick, and 3 feet wide.

Fifth. The face of each ashlar in the front of the quay wall is to have a chisel-draught wrought round it, and the space between this is to be neatly and straightly broached. The beds, sides, and ends of these stones are to be fair broached round for at least 1 foot inwards from the face; the other parts, as well as all the ashlar in the wall and counterforts, are to be neatly hammer-dressed, so that they may lie fair together at the sides, ends, and beds. When a course is laid, the small openings are to be filled with grout and spauls, to be well crammed into them with an iron bar, so that the whole may form one solid body or mass of masonry. After each course is laid, the upper bed of the course is to be straightened with a punch, to make it straight to receive the next course. The coping stones are all to be die-square, to the dimensions specified, and the bed to be done as the other ashlars; but the joints to be neatly squared, the face grooved as the others, and the upper side neatly grooved.

Sixth. At the distance of 12 inches from the face of the quay-wall a groove is to be cut in the upper bed of the fifth and twelfth courses, counting from the foundation, parallel to the face, and to be turned from thence along the middle of each counterfort to within one foot of its extremity, and there to terminate in a cross groove of 2 feet in length, large enough to receive iron bars to bind the masonry together. The stones to receive the cross bar are to be stretchers, whose lengths shall be equal to the thickness of the counterforts, and not less than 2 feet 6 inches broad. The bars are to be run in, and wholly covered with lead.

Seventh. The joints of the ashlars in the quay wall, for at least 3 inches inwards from the face, are to be laid in Parker and Co.'s Roman cement, and for 9 inches farther (except the eight undermost courses, which are to be laid throughout with this composition) with cement to be prepared as follows:—namely, one part of well-burnt pounded or ground lime, one part of burnt ironstone pounded, and two parts of clear river sand, free from earthy particles; the lime to be burned adjoining the works, and to be used hot; these pounded materials to be mixed with their due proportion of sand, and then put through a fine skreen and mixed with water, and well beaten or ground with millstones previous to their being used; but no more must be mixed with water than what is necessary for the day's work, and the other must be covered with sand, so as to keep it free from the air. Such parts as may be liable to be covered with water while building are to be covered with Parker and Co.'s cement. The backing stones are to be laid flush in mortar, which is to be made from lime from Netherwood, Campsie, or Kilbride quarries, mixed with shells in proper proportions.

Eighth. The stones for the face of the quay wall may be taken either from the under part of Black Quarry, or from the Millstone, Westmuir, or Firewick quarries, at the option of the contractor, provided that the whole face shall be taken from one of them, as no mixture will be allowed in this part of the building. The stones for the backing or counterforts may be taken from all or any one of them, or part from Carntyne or Cowcaddens quarries; all the stones are to lie on their natural beds, and no stone with a soft surface, or otherwise faulty, will be suffered to be used.

Ninth. The contractor for the digging of the foundation, the making and forming of the cofferdam, &c., may commence his operations as soon as a contract can be entered into; and he is to have part of the foundation ready for the building by the beginning of March next, and to continue onwards with his work, so as to have always a sufficiency for the contractor for masonry work, according to the rate it shall be agreed on; that he, the contractor, is to proceed, and the contractor for the masonry is to prepare the necessary materials and implements, so as to be ready to begin building on

No. 329.
Rennie's Specification for the new Front or Quay Wall, at the Broomielaw.

the 1st March next, provided the weather shall then permit; and he is to proceed with his work in the following manner, and at the after-mentioned rate, namely—one half-rood of superficial measure in each week of working weather, and that weather to be ascertained by the superintendent.

Tenth. The estimate is to be given in by the cubic yard; in that price is to be included the workmanship and whole materials of every kind, as well as the masons' sheds, scaffolding, foot-gangs, tresses, and every other kind of machine or implement necessary for such an undertaking. It is also to include the making of the grooves along the whole two fore-mentioned courses of the quay wall and counterforts, and running in the iron bars. The trustees will provide the iron and lead. The contractor is to throw the stone shivers and rubbish, which may be collected by his operations, behind the puddle of the wall, without any additional charge. In making out this estimate, too, the work is to be classed under the three following heads, and the price is to be made accordingly:—

1st. The breast-work, measuring three feet inwards from the face, is to be squared and charged at per cubic yard.

2nd. All the other walls are to be squared and charged at per cubic yard.

3rd. The coping course is to be squared and charged at per cubic yard.

Eleventh. So soon as the contractor shall have finished two superficial roods of the breast-wall, with the corresponding counterforts, the work shall be measured and paid for in full; and so on in the same proportion until the whole be completely finished. The contractor is to find ample security for his engagements, to the satisfaction of the trustees, to the effect that he will not only begin, carry on, and finish the work herein described, in the time already fixed, but that the whole shall be done in exact conformity to this specification.

Twelfth. As the trustees are determined that these works at the Broomielaw shall be done with the very best materials, and executed in the first style of workmanship, one clause will be inserted in the contract appointing a superintendent or superintendents, and one prohibiting the contractor from setting out by piece-work to his own workmen, or any other master mason, all or any part of the building, or the mixing or preparing of cement or mortar, which must all be done by men working on day's wages, without prejudice, however, to the contractor's getting the stones quarried, carted, or hewed by piece-work.

The estimates are to be given in to James Black, Esq., Lord Provost, on or before the day of

JOHN RENNIE.

No. 330.

Report by T. TELFORD, Esq., *on a Wet Dock in the Ground belonging to* Dr. REID.

No. 330.
Telford, on a Dock in Dr. Reid's Ground.

SIR, *Glasgow Dock.* *London, December* 29, 1819.

IN pursuance of your instructions, and upon the data contained in the plan and section you transmitted, I have, upon the plot of ground denominated Mr. Reid's property, formed the plan of a wet dock, 750 feet in length, and 200 feet in breadth, which leaves a sufficient space for wharfs, warehouses, sheds, and entrances, all as delineated upon the accompanying drawing.

In regard to locality, this dock seems favourably situated, one end having a convenient communication with the river, and the other with the principal street of the city, without interfering with any private property, excepting Mr. Reid's field.

With respect to height, I have (as may be seen in the sections) made the top of the wharfs level with the flood-line at the Saltmarket, in March 1782, which, being 19 inches higher than the same flood below the bridge, seems sufficiently out of the water. Allowing 5 feet below the top of the wharfs for the average height of water in the dock, and 12 feet of depth of water gives 17 feet below the wharf-line, and allows for a greater depth of water if necessary.

The breast of the wharf at the Broomielaw is 12 feet 4 inches below the flood line at the Saltmarket, and 4 feet above high water at a spring-tide, making together 16 feet 4 inches; to this, if 12 feet water be added, makes 28 feet 4 inches below the before-mentioned flood-line (or that assumed for the top of the wharfs around the dock), gives the bottom of the entrance lock, which leaves a rise or silt of 11 feet 4 inches. And it will, by the section, be seen that the bottom of the entrance lock is as nearly as possible on a level with the bottom of the river.

Between the wet dock and the river there is a sufficient space for a graving-dock and building-yard, a very necessary appendage to a port, also for placing a steam-engine to supply the wet dock and its lockage water.

This General Report, with the annexed drawings, are sufficient for all preparatory measures, also obtaining an Act of Parliament, and commencing the excavation. For the dock walls, entrance lock, and other works, particular working drawings will be necessary.

THOMAS TELFORD.

To James Spreull, Esq.

No. 331.

Report by T. TELFORD, Esq., *recommending the Extension of the Bromielaw Quay as the most advisable mode of getting additional Berthings and Wharfage.*

Broomielaw.

London, December 20, 1821.

No. 331.
Telford, on extending the Broomielaw Quay.

HAVING inspected and considered the present state of the river and banks at, and adjacent to, the Broomielaw, also perused the Report of the Committee of Trustees of the 13th April, 1820, and had sundry conferences with the Chamberlain, I beg leave to state—

1. That there do not appear to be any good grounds to expect such increase of revenue as to justify incurring any very considerable expense.

2. That encroaching upon the river, in almost any shape, would either risk interrupting the high floods, which of late years have frequently taken place, or seriously injuring the navigation channel.

APPENDIX C.

GLASGOW.

No. 331.
Telford, on extending the Broomielaw Quay.

3. That acquiring increased accommodations on the south side of the river would render the access with the City very incommodious, and could only be obtained at a great expense.

4. From the foregoing considerations, I am disposed to recommend that, for the present, berthings and wharfage for the steam-boats should be obtained on the City side of the river, between the western end of the Broomielaw and opposite Clyde-street. This may be conveniently done, by excavating a recess of from 20 to 30 feet behind the line of the Broomielaw wharfs, to admit the steam-boats to lie out of the course of the current and navigation channel. And in order to accomplish this in the most economical manner, I advise that the wharfage be formed by means of piles and planking. The number and dimensions of these piles depend so much on the nature of the ground as scarcely to be previously determined; it will be necessary to drive a row of plank piling to protect the earthen bank; the length of these must also be determined upon trial; but the whole process is so plain and familiar to the Chamberlain, that he will be at no loss to give the necessary directions, and, if required, furnish an estimate of the expense.

THOMAS TELFORD.

No. 332.

No. 332.
Reddie, on deepening the River.

Letter from MR. REDDIE *to* MR. WHIDBEY.—*Queries as to Deepening and Improving the River.*

SIR,

Glasgow, September 1, 1824.

I AM directed by the magistrates and Council of Glasgow, as trustees for improving the navigation of the Clyde, to request you will inspect and examine the river, and the works hitherto constructed for the improvement of its navigation; and after considering the reports formerly made by the late John Rennie, Esq., and other civil engineers, give the trustees your opinion and advice with regard to the following points:—

1. By what means, in general, a greater depth of water may be obtained in the Clyde, throughout its channel, than at present, and for a longer period during each day? Whether by proceeding with the plan and operations hitherto adopted, or by adopting any other or different plan?

2. By what means the bed or channel of the Clyde may be farther excavated and reduced, so as to bring it nearer to the level of the harbour of Port Glasgow; whether by the operation of the dredging-machine moved by steam, lately constructed, or otherwise?

3. By what other means, besides the deepening of the bed of the river, the tide may be made to flow up more abundantly than at present, so as to secure a greater depth of water for a longer period? Whether, by completing and raising the dykes on both sides of the river, or by directing the tide and current more judiciously and advantageously than at present, if practicable, or otherwise?

4. Whether the openings left in the dykes on the side of the river, for salmon-fishing stations, for access to the river, for stones, manure, &c., are injurious in preventing the depth of water which would otherwise take place in the navigable channel? And, whether some of the rights of fishing which are most prejudicial to the navigation ought not to be purchased or taken in lease, so as to admit of the dykes being carried in one uniform line? In particular, whether the fishing-station belonging to the town of Renfrew, near the west termination of the present works, ought not to be acquired so as to admit of the dyke being closed up, and the waste of tide to the south of it prevented?

5. What means should be adopted, besides the dredging-machine, and the direction of the current by the dykes, for removing the banks or shoals which run across, or nearly across, the river at particular places, such as the shoals near Govan, Linthouse, Erskine, &c., and the banks opposite the Leven at Dunbarton, and near Port Glasgow?

6. What further works ought to be constructed in the lower parts of the river where it merges into the Frith or sea, for the purpose of forcing up a greater supply of tide by the direction of the current or otherwise?

JAMES REDDIE.

No. 333.

No. 333.
Whidbey, on the River Clyde.

Report by J. WHIDBEY, Esq., R.N., *on the necessity of a free flow of the Tide up the River Clyde.*

GENTLEMEN,

Plymouth, September 25, 1824.

IN consequence of an application having been made to me, stating that it was your wish that I should visit the river Clyde, and examine the works being constructed for the improvement of its navigation, and take into my consideration the reports of several engineers on the same subject, and give my opinion and advice with regard to the questions put to me by Mr. Reddie, as directed by the magistrates and council of Glasgow, relative to the works now being constructed in the river Clyde, for the purpose of obtaining more water therein, and also for protecting the fisheries,

I beg to inform you that I have read all the reports of the civil engineers, and I have seen the river Clyde as low as Port Glasgow, and I exceedingly regret that so much has been recommended in the Reports, and so much done to ruin the river Clyde. The object appears to me to have been the obtaining of land from the river, in preference to preserving the latter; and, if I may so term it, there is a canal now being completed in the river (the width of which is contracted to about one-third of what it originally was), by throwing stones down on each side to form the canal, and contracting the width of the river to 440 feet, where it used to be 1400 feet. The tide is thus prevented from flowing over the space it usually did, whereby the scouring effect is greatly diminished.

It is needless for me, at this enlightened period of time, to mention to you the number of rivers and harbours that have been destroyed by embanking and making land on the sides of them; and I am afraid such will be the case of the Clyde, if the present work is to be proceeded with. I do not mean to say but the present depths in this new canal may be preserved by repeatedly dredging up the shoals as they form, which may constantly be expected to be the case. But this is not the only

APPENDIX C.

GLASGOW.

No. 333.
Whidbey, on the River Clyde.

danger to be feared; for I am seriously of opinion that so much of the flowing tide being prevented from flowing into its usual receptacles, will be the cause of banks and bars forming even far below Port Glasgow, and preventing vessels from getting up to Glasgow that go there at this time with ease. During my stay at that place I could not obtain any account of the soundings about the entrance of the Clyde, either of ancient or modern date, and therefore I could not discover if any alteration in the depths of water had taken place since the commencement of the works on the Clyde; but, judging on general principles, I am afraid that banks and bars will grow up at the entrance of the Clyde; for it stands to reason, that if a large body of water is allowed to flow up a river, its body and weight are forced against the river stream, and that stream is kept higher up in the country, and more water finds its way up; and when it ebbs, the greater is the scouring effect, and will be the means of keeping the river deep, and prevent shoals and banks forming. But if the river is contracted, and the tide prevented from flowing into its ancient recesses, the ebb tide must be reduced in quantity, and be less capable of producing these effects; for all rivers bring down from the country a great quantity of rubble, mud, &c.; and if there is not a sufficient body of back water to carry the same into deep water, banks and bars will form and destroy the navigation.

Having thus given you my opinion on the state of the Clyde, I now beg to offer you my opinion of what ought to be done to prevent it from being entirely ruined; and I beg to recommend a stop being put to all the proceedings that are now going on in the Clyde; and if you could undo all you have done it would be a good thing. There never ought to have been more done to the Clyde than paring away the points, and filling the deep indents of the shores, so as to have allowed the tide to have flowed along the land without interruption. If you had proceeded in this way, making land in some places and taking it away in others, you would have had no cause to have done anything more.

I have said that if you could undo all you have done it would be a good thing; but that cannot be accomplished. I do not think that anything can be done higher up the river than Nushat Island. Below that island all the jetties, but more particularly those on the south side of the river, should be broken through, and the tide of flood be allowed to flow freely up to Nushat Island, by which means a great body of back water will be restored, and the fisheries will be preserved. If this is not done, the spaces between the jetties will soon be land. The dams at the bridges, or weirs, should be removed, and dug down to the lowest ebb that ebbs along the Broomielaw, and allow the tide to flow above the town, as the level of the land above will allow it. This being done, the sand and mud should be dug out between the bridges, and also some distance above them, so that the tide may flow freely up, which will produce a large body of back water, and assist in scouring out the river below. I am afraid the river will soon want such a reservoir, as I understand there are some shoals that have lately grown up, one of which is at a place called the Cart, about seven miles below Glasgow, where there are only four feet of water at low water spring tides, and this shoal extends across the river; and as there is only about 10 feet rise of tide at the springs, there are only 14 feet at high water spring-tides. Under these circumstances, I recommend the dredging-machine to be used in lowering these banks as they get up, that being the only means left, together with what I have before proposed, for preserving the river for navigation.

J. WHIDBEY.

To the River Clyde Trustees.

No. 334.

Report by MR. JOHN CLARK, *on the Improvement of the Navigation.*

No. 334.
Clark, on the Improvement of the Navigation.

MY LORD AND GENTLEMEN, *Clyde Bank, November* 11, 1824.

IN compliance with the desire of the Committee of Management, I beg leave to report my opinion on the further improvements of the navigation of the Clyde.

Having repeatedly examined and considered the whole, I beg leave to state my sentiments under the following particulars, viz.—1st, The leading or bringing up of a greater quantity of tide water. 2. Dredging with the steam-power machine, or with the porcupine plough, in the few places where the bed of the river may be too hard for the machine to operate upon it.

In order to obtain a greater quantity of tide water in the upper part of the river, the general principle is to reduce the bed of the river to that form which shall afford the most direct course, oppose the fewest obstacles, and render the least possible friction to the flowing water.

The mode which has been pursued for twenty years back, of running parallel or connecting dykes, as marked on the plans with small dotted lines, has had a most visible effect in deepening the river. By looking back to the year 1806, it would appear that at that time the largest vessels in the Liverpool and Bristol trade drew 8 feet 6 inches of water. The vessels now in the Liverpool trade draw 11 feet, and yet effect their passage up the river with less detention than the former vessels did at that period, and in no other way has this been effected but by the continued extension of parallel dykes; and I can confidently affirm that the new dredging apparatus has raised more stuff since set to work than has been taken out of the river for the last 20 years.

That the river may be brought into the most perfect form, it is necessary that its banks and the parallel dykes be completed in the same manner as at those places where the machine has been at work, and where the stuff raised by the machine from the bed of the river has been deposited, and the parallel dykes brought up to their proper height. I would, therefore, recommend that the parallel dykes below Dunglass, on the south side of the river, be completely connected, and that the long dyke be continued till it terminate on the south shore, at the West Ferry, opposite Dumbarton. Were this done it would have a great tendency to bring up the early part of the tide, and cause a more uniform velocity in the channel of the river. At present a very great quantity of the flood-water passes up behind the Long Dyke, and after accumulating there till it rises above the height of the dyke (for at present the tide flows more rapidly on the south of the dyke than in the channel), it then falls into the navigable part of the river, and checks its current.

From the head of the Long Dyke through the Lungoch Bay, the current is very languid, owing to the waste of water entering that bay, the parallel dykes not having been connected in consequence of the ground being a fishing-station belonging to the burgh of Renfrew; and as the section of the river is wide at that place, the current is not able to convey to seaward the quantity of sand brought down by the floods, and which subsiding, contributes to this evil. But as the fishing at this place brings but a small sum, I hope it may be bought up at an easy rate.

APPENDIX C.

GLASGOW.

No. 334.
Clark, on the Improvement of the Navigation.

As the section of the river, from a little above Dunglass Castle to the Canal Company's Dyke, is wide, sand-banks frequently accumulate, I would advise running a parallel dyke from a little above Dunglass Castle to opposite Mr. Scott's property, on the north side of the river, leaving a space in the bay for the convenience of the canal trade, and for vessels going out of and in to the ship-builder's yard.

From a little below the Old Ferry Quay on the north side of the river, the property of Mr. Speirs, of Elderslie, parallel dykes are wanted to join the Scotstown estate; and although Mr. Speirs declines bearing a part of the outlay, I am, nevertheless, of opinion that it ought to be done, for this reason, that the nature of the bottom of the river is such that it would scour itself, and in a great measure save the expense of dredging.

The operations thus recommended, there is every reason to expect, will be the means of bringing up more tide water, and deepening the bed of the river, thereby facilitating the navigation; and the above appears to me the most advisable plan, although of course the works are of such a nature that a great deal will depend on their being accurately laid off, and properly executed, according to Mr. Rennie's plan.

Having considered what regards the general form of the river, and the procuring of a greater depth of water, it now remains to provide more harbour-room at the Broomielaw.

To convert a portion of the ground on the south side of the river into a harbour appears to me the best plan. A certain portion of the ground opposite to the present quays should be first applied as harbour accommodation, and the section of the river at that place should be considerably extended, so as to allow the floods an easy passage, and in a more direct course than at present. It further appears to me, that when the section of the river here is made of a sufficient width, the quay upon the south side should be on the same level as that on the north, which would give a considerable quantity of room for depositing the stuff taken out of the harbour, and save the expense of shifting it to a greater distance. I am also of opinion that a breast-work upon the same principle as that lately constructed for the steam-boats might answer very well for the intended wharf, only I would advise that the front piling should be three feet longer, and somewhat thicker.

I have, &c.,

JOHN CLARK.

To the Honourable the Lord Provost, Magistrates, and Council of the City of Glasgow, Trustees of the River Clyde.

No. 335.

Report by T. TELFORD, Esq., *on enlarging the Broomielaw Harbour.*

No. 335.
Telford, on the Broomielaw Harbour.

London, March 10, 1826.

UPON the accompanying drawing, signed by me and dated 10th of March, 1826, are a plan and two cross sections, upon which are delineated the portion of the southern river bank which I recommend to be excavated, on purpose to enlarge the Broomielaw harbour, and construct extensive quay room on the southern side of the river.

On the plan and section the ground to be excavated is coloured red, and the space to be filled up is marked upon the sections with a yellow colour.

As a regulation for the height of the new quays, I have considered that the present Broomielaw wharfs shall be raised 16 inches opposite West-street, and 30 inches opposite Commerce-street; and that the new quays on the southern side of the river shall be on the same level. With regard to depth I have considered the bottom of the intended excavation as at 22 feet 9 inches below the level of a line extended from the surface of the foot-path pavement at the corner of Commerce-street, and which is 8 feet under the surface of high water on the 30th of August, 1824, all as delineated on the accompanying sections.

Proceeding upon these data, I have fixed the excavation in its cross section, which forms an obstruction to the flood waters, at somewhat more than double the obstruction which would be created by the filling up above the present surfaces on each side of the river; and this I consider to be sufficient to provide also against any obstruction of any additional quantity of shipping which may be brought to the harbour on account of the new wharfs or quays.

The proper adjustment of the quantity of water-way is of equal importance to the Broomielaw harbour, and the inhabitants of the lower parts of the city.

With a view to expedition and economy, I propose that the intended new wharfs shall be constructed with timber, after the manner of the late extension on the northern side of the river, and as this has, I understand, answered the purpose, I see no reason to change from a mode which must from experience be familiar both as to construction and cost.

THOMAS TELFORD.

To James Reddie, Esq.

No. 336.

MR. HARTLEY'S *Report on the Broomielaw Harbour, and Construction of Docks.*

No. 336.
Hartley, on the Broomielaw Harbour and Docks.

GENTLEMEN,

Liverpool, April 30, 1834.

IN compliance with your resolutions of the 24th February and 6th March, and of your personal directions of the 4th of April instant, I beg to state that I have surveyed the proposed line of the south quay wall of the Broomielaw harbour. I have also surveyed the river with a view to the improvement of the upper navigation above the Jamaica-street Bridge, as well as of the improvement of the harbour generally; and beg respectfully to state to you as follows:—

Line of the South Quay Wall of the Broomielaw Harbour.

In respect of this line, as laid down in dotted lines upon a plan drawn by Mr. Atherton, dated the 27th August, 1833, and which dotted line bears my initials in blue ink (namely, J. H.), I do not see that such line can be improved. Whatever other additions it may be considered desirable to be

APPENDIX C.

GLASGOW.

No. 336.
Hartley, on the Broomielaw Harbour and Docks.

made, I am of opinion that such is the proper line to be adopted, whether as regards water space or convenience for trading vessels, because it is, under all circumstances, desirable that when vessels are in harbour they should, if possible, lie alongside of a quay; and if the river when widened to the proposed line of new quay will not afford ample convenience of quay space, and vessels will have to lie in the river any considerable time, till they can take their turn at a quay berth, it is very clear that more accommodation will be wanted, and which accommodation would not be afforded by an increased width of the river.

I have also examined Mr. Atherton's plan and specification for the erection of the said wall, which I returned to him by the "Vulcan" steam-vessel, on the 26th instant, with such remarks thereon as appeared to me to be necessary.

In the event of further accommodation being required, it must be borne in mind that the wharfs should be situate so as to require the least possible quantity of cartage; and if my ideas of the localities of the trade of Glasgow and its neighbourhood be correct, I consider that Glasgow Green is the most proper place for such general accommodation. Under such impression, I would propose as follows:—

That the width of the river should be reduced to 300 feet from the face of the west abutment of Hutcheson's Bridge, and the face of the west abutment of the proposed Glasgow Bridge; at the extremity of 300 feet from, and parallel to the face of those abutments, I would build a substantial wall to support a canal of about 110 feet in width, to be kept at a level of about 2 feet above high water of spring tides, beyond which, for a length of about 1500 feet, viz. from the proposed Glasgow Bridge to the Old Bridge, there would remain a space for street and quay of 120 feet in width;—from the Old Bridge to Hutcheson's Bridge, a length of 900 feet, there would be a space of quay of 50 feet; as, however, there are no buildings beyond that line, but for which far more desirable sites might be found, I conclude there would not be much difficulty in having that width extended, to the width that may be found most convenient; beyond this point, upon the Green, there is a space sufficient for docks of any size and shape

In order to make the canal of the greatest utility, I should recommend a weir of considerable length to be constructed near to the Cranstonhill Water Works, elevated about 2½ feet above high water of spring tides, having a considerable portion of its height to be made to strike on the occurrence of heavy land floods, &c.; by this weir the docks and canal would be fed, and the canal might be rendered available, when desired, for passing off a large portion of the land floods.

Such canal to be entered from below Glasgow Bridge, by means of a lock, or the portions of it situate betwixt each bridge might be made available as locks, or half-tide basins, which latter would probably be the more desirable.

By this method no weir would be needed, except almost beyond the influence of the tide, a great facility would in consequence be given to the scouring of the channel, and the present bed would be naturally so far deepened as to admit of barges (with striking masts) to navigate the same, with the flood and ebb to and from above Hutcheson's Bridge, where they might lock into or from the canal and docks.

It may be objected to this plan, that the transit of passengers across the river would be inconvenienced by the passing of vessels across the ends of the bridges from time to time, to which I reply, that no benefits can be had without some sacrifice or other, and bridges may be so constructed as to give but very little obstruction. It is to be regretted, however, that the present bridges have been constructed without much consideration, either to the passing of the water or of the land passengers.

If this plan herein proposed were to be adopted, it would be desirable, though not absolutely necessary, that those bridges should be rebuilt in a manner to meet alike the convenience of the river and the land, and that permanently; and which would be effected at a much less expense than may be generally imagined. If the foregoing plan be objectionable, the next is, to make a wet-dock of the Windmillcroft, belonging to the City of Glasgow, to be entered from the river by a lock of suitable dimensions: such dock would be about 1200 feet by an average of 300 feet, and should be fed by the Ardrossan Canal, so as to be kept at a level of at least 2 feet above high water of spring-tides; by this means, neither expensive excavations nor quay walls would be needed; and the dock once filled, the supply would only be required to make up the waste by lockage. If docks on this west side of the river would be equally as convenient to the trade as on the other side, it would be easy to extend them to the westward, as might be required. It must, however, be observed, that, in Liverpool, it is considered that no first outlay can be worth consideration, if a certain and constant distance of cartage can be saved; on this consideration, the erection of docks at Hunter's Slip cannot be countenanced.

I send herewith a sketch, explanatory of my ideas, and am, &c.,

J. HARTLEY.

To the Dean of Guild and the Committee of Management
of the River Clyde, Glasgow.

No. 337.

No. 337.
Sums paid for Surveys, Reports, &c., 1752–1834.

Statement of Sums paid to Engineers for Surveys, Reports, &c., for Improving the River Clyde and Harbour of Glasgow, from 1752 *to* 1834.

	£.	s.	d.
1752—John Stirling	28	4	4
1756—John Smeaton	21	0	0
1758— Do.	91	11	0
1760— Do.	43	0	0
Do.	69	0	0
1769—John Golborne	85	0	0
1770—J. Watt	20	0	0
John Golborne	21	0	0
Do.	29	14	2
J. Watt	21	14	0

APPENDIX C.

GLASGOW.

No. 337.
Sums paid for Surveys, Reports, &c., 1752—1834.

	£.	s.	d.
1771—John Golborne	105	0	0
1800—John Rennie	35	0	0
1802—Wm. Kyle (for Plan of River)	99	12	5
1803—John Rennie	16	1	6
1806—Thos. Telford	18	10	8
1808—John Rennie	51	1	0
1809— Do.	93	4	9
1810— Do.	41	3	5
1811— Do.	37	7	0
1812—R. Buchanan	35	0	0
1817—John Rennie	7	7	0
1821—Thos. Telford	150	0	0
1825—Mr. Whidbey	260	0	0
1826—Wm. Kyle, for taking soundings of the River from Glasgow to Port-Glasgow	108	6	11
1827—Robert Stevenson	11	11	0
Thos. Telford	236	10	0
1831—Robert Stevenson	13	4	6
1833— Do.	85	2	1
1834—Mr. Hartley (not yet rendered)	0	0	0

Taken from the books of the Trustees for Improving the River Clyde, by

JOHN SPREULL, *Treasurer.*

Glasgow, Oct. 8, 1834.

No. 338.

Report on the Improvements of the River Clyde and Harbour of Gasgow, ordered by the Parliamentary Trustees, with Tables of Soundings and Borings, by DAVID LOGAN, Esq., C.E.

No. 338.
Logan, on Improvements in the River and Harbour, with Soundings and Borings.

GENTLEMEN, *Glasgow, October* 5, 1835.

THIS Report is explanatory of certain improvements, which have been suggested to me by an examination of the localities and resources of the noble river under your management, engaged in by me with due consideration of the vast interests it involves, and highly sensible of the importance of the duties which you have done me the honour to assign me.

I have sketched my views on a map laid down by Mr. Wm. Kyle, Land Surveyor, of the accuracy and correctness of which I beg leave to offer my most unqualified acknowledgment.

I have now the honour to transmit this sketch, and to accompany it with a drawing of the longitudinal and transverse sections, made out by me, to which reference is often made in the following Report:—

On beginning my survey of the river, in reference to the improvements of which it is susceptible, and which the increasing trade requires, I found the documents put into my hands so insufficient to enable me to come to a satisfactory conclusion, respecting the information required from me, in terms of your Resolution of 16th October last, that I was obliged to undertake new and extensive surveys; not only to examine carefully the course of the river, its tides, to take longitudinal and transverse sections, but to make an extensive set of borings in the bed of the river, in order to ascertain the existence or non-existence of impediments to deepening the fairway; and I have the greatest pleasure in communicating to the trustees that this investigation (as will be seen in an after part of this Report), has turned out in the highest degree satisfactory, for by it we have ascertained, what could be shown in no other way, that no obstacle lies in the way of deepening the channel of the river to any depth that may be required.

For the sake of method, I have made certain arbitrary divisions of the length of the river, as heads under which to lay before you the substance of my observations on the following topics:—

I.—Of the bed or channel of the river as to its course or direction.
 a Course or direction.
 b Width or transverse section.
 c Longitudinal section, and the result of the borings of the deposit, and other matters in the bed of the river.
 d Certain points, or projections of the neighbouring banks, which, in reference to the improvements contemplated, must be specially noticed.
II.—Observations regarding the tides.
III.—Certain principles to be kept in view as the foundation of future proceedings.
IV.—The improvements which the foregoing observations suggest.
V.—And, lastly, the estimate of the expense of executing the improvements.

I.—*Of the Bed or Channel of the River.*

The First Division extends from the west end of the Steam-boat Quay, Broomielaw, to Govan Ferry, a distance of about 2,690 yards.

Its course is pretty straight, with a bearing of N.W. by W. (the general bearing of the whole river down to Dumbarton Castle), till opposite Clyde Villa, the property of Edward Clarke, Esq., where it takes a very sudden sweep, in a northerly direction, till it reaches the east boundary of the lands of Kelvinhaugh and York Hill; again it turns quickly in a westerly course, in which it continues to Govan Ferry.

A reference to the plan is requested, to show some other variations of width of less importance at intervening points.

The width of this division at the quay is about 163 feet, varying little till it reaches the bend opposite Mr. Clarke's villa, where it is 280 feet; after narrowing a little, it suddenly attains, at the east boundary of Kelvinhaugh and York Hill property, a width of above 300 feet; at Govan Ferry its width is again reduced to 170 feet.

By perusing the table of soundings, and the drawing of the longitudinal section of this, as well as of all the other divisions of the river, information respecting the depth will be more readily and dis-

APPENDIX C.

GLASGOW.

No. 338.
Logan, on the Improvements in the River and Harbour, with Soundings and Borings.

tinctly acquired, than by any written detail. But we may state generally, that in the course taken by the craft on the river, the depth varies in this division from 13½ feet, to 17 feet 5 inches, but in the centre of the river from 11 feet 11½ inches, to 17 feet 4 inches.

All the soundings, referred to in the above and following observations, are taken from the transverse sections of the bed of the river, and taken from the average of high water of neap tides.

In this division sixteen borings were made, varying from 7 to 32 feet below the present bed of the river. The instrument employed penetrated with great ease and rapidity; and the deposit, or material of the bed, was found to consist in various places (for which see table of borings) of sand, mud, and gravel, in a very loose state of aggregation.

To save unnecessary details, respecting the projections, reference is made to the plan of the improvements laid down on the map. But, we may state, in respect to all these points so denominated, that they are those portions of the banks which, jutting into the stream-way, cause its windings, present obstacles to the free ingress of the tides, check the current downwards, lessen its scouring power, and constitute the portions of the banks which are included within the red line laid down by me on Mr. Kyle's splendid map of the river.

The Second Division extends from Govan Ferry to Renfrew Ferry, a distance of about 5,700 yards.

From Govan Ferry the river runs in a straight course, till it reaches Hayes Burn foot, where it bends in a more westerly direction, as far as about 300 yards west, of the east boundary of the lands of Shieldhall, the property of James Oswald, Esq., M.P., here it changes to a northerly direction for about 900 yards, again gently turning westward for 400 yards, after which it takes nearly a direct line to Renfrew Ferry.

The width of the river increases, from 170 feet at Govan Ferry, to 270 feet at Renfrew Ferry, viz.—

	Feet.
Opposite Hayes Burn foot it is	200
Opposite the east boundary of the lands of Shieldhall . .	210
At the Old Ferry, Renfrew	230
At the present Ferry, Renfrew	270

The course, taken by vessels in this division, varies in depth from 13 feet 8 inches, to 20 feet 1½ inches, and in the centre of the river, it varies from 11 feet 9½ inches, to 17 feet 6½ inches.

There were 28 borings made between Govan and Renfrew Ferries, varying in depth from 6 to 35 feet below the present bed of the river; the material of which was found generally to consist of sand, mud, and gravel, except for about 30 yards in length, opposite Crawford's Quay, where I found tough clay mixed with small stones.

For the projections I beg to refer you, as before, to the plan of improvements suggested, and laid down in red colour on the map.

The Third Division runs from Renfrew Ferry to Donald's Quay, a distance of 4½ miles.

From Renfrew Ferry the river takes a northerly course, passing the River Cart in an easy sweep northwards; from this point it runs in a straight line as far as the centre of the Nushat Isle, where it takes a quick turn, and runs again in a westerly course (forming a slight curve), as far as the quay at Rashalee Quarry; here it bends suddenly, and runs in a northerly direction to Donald's Quay.

The width of the river in this division is as follows:—

	Feet.
At Renfrew Ferry	270
Narrowing at Yoker Burn to	235
At the River Cart the breadth increases to . . .	280
At Dalmuir Quay to	350
It still widens as it descends at Rashalee Quarry to . . .	450
At the termination of the stone embankment on the south side, about 1,200 yards west of Rashalee Quarry, it is only . .	400
At the end of this division, or at Donald's Quay . . .	430
The breadth is very irregular at all the intervening points.	

The bottom of the river from Renfrew Ferry to Donald's Quay is very irregular. The depth of the course generally followed by vessels, varies from 13 ft. 2 in. to 20 ft. 6¾ in., and in the centre of the river, from 9 ft. 7½ in. to 15 ft. ½ in.

In this division there were 42 borings made; these varied in depth, below the bed of the river, from 6 to 35 feet. The deposit or material is for the most part composed of sand, mud, and gravel, as far as Park Quarry Wharf. From Park Quarry Wharf to North Barr House, the bottom consists of hard red clay, intermixed with small stones; at North Barr House, the bottom is clean sand and gravel; and, again at Castle Porridge, about 400 feet in length of the bed, on the north side of the river, is composed of very hard clay, mixed with stones. It was with great difficulty that the augur was made to enter here. The boat had to be shifted several times before there could be a place found free of stones; notwithstanding, we had the satisfaction of boring 9 feet, a depth sufficient for the proposed improvements. At this part of the river there have been several very large stones removed from its bed, by means of the diving bell.

The first projection in this division commences at the west boundary of the trustees' property, and increases gradually in breadth until it reaches the River Cart, where it is 160 feet in breadth; that is, from the base represented by the red line on the map. From the Cart it lessens gradually, and ceases to project at a distance of 1,200 yards. At this point the river recedes to the north of the red line, so that there is no projection for about 900 yards. A second projection commences 670 feet east of Dalmuir Quay, and immediately opposite Park Quarry Wharf (a distance of 858 yards), it projects 280 feet, and continues at a breadth parallel with the red or base line, until it reaches opposite Rashalee Quay, a distance of 400 yards; and 600 yards farther westward, the red line intersects the present line of the river, and so the projection ends.

The surface of the ground forming these projections is at present of little value, being generally overflowed by the tide, and bearing only coarse grass and reeds, with the exception of a small portion of ground, the property of James Lumsden, Esq.

On the south side of the river, in this division, the first projection commences at Renfrew New Pier, and is about 120 or 130 feet in breadth: it gradually diminishes, and terminates at the west boundary of the town of Renfrew's property, a distance of about 800 yards. The next projection on this side commences at Nushat Isle, about 800 yards west of the River Cart; its greatest breadth or projection

APPENDIX C.

GLASGOW.

No. 338.
Logan, on the Improvements in the River and Harbour, with Soundings and Borings.

is opposite the centre of Nushat Isle, and measures 260 feet; and at a distance of 750 yards more comes to a point. The third projection is formed by a rubble embankment: it commences about 45 yards west of North Barr House, and projects 90 feet; at its west end, a distance of about 500 yards, its projects 185 feet. The whole surface of this projection is composed of alluvial matter, and is flooded every tide, as is also the case with the projection at the Nushat Isle.

The Fourth Division extends from Donald's Quay to 380 feet west of Dumbarton Rock, a length of about 4½ miles.

From Donald's Quay, the river runs in a direct line for about 1,100 yards, or opposite Bowling Bay Entrance Lock (in part of which, on the south side, there is no rubble embankment to confine the channel), from Bowling Bay it runs in a more westerly direction as far as Dunglass. From Dunglass it takes a course nearly straight, and almost true west, its northern limit passing about 700 feet south of Dumbarton Rock.

	Feet.
The width of the river at Donald's Quay, is	430
It increases at Bowling Bay to	530
And at Dunglass it decreases again to about	410

There being no rubble embankment on the north side, between Dunglass and Dumbarton Rock, the average width is taken from low-water mark, and is 600 feet and upwards.

The course generally taken by vessels, varies in depth from 13 feet 4½ inches, to 23 feet 6 inches, and in the centre of the river, from 10 feet 2¼ inches, to 21 feet 9 inches.

Twenty-one borings were made between Donald's Quay and Dumbarton Rock, varying in depth below the present bed of the river, from 6 to 25 feet, the material of which is generally composed of soft sand, mud, and gravel, which can easily be removed by the dredging-machine.

There are none in this division, with the exception of part of the rubble embankment on the south margin of the river, at Bowling Bay, to a little west of Dunglass Castle.

The Fifth and last Division (it is not included in the estimate of expense) extends from Dumbarton Rock to Port-Glasgow.

The channel between Dumbarton and Port-Glasgow has a general westerly bearing, and is of considerable breadth, between which places there is no impediment to the navigation, with the exception of a small bank, the east end of which commences at about 1,500 yards below Garmoyle Light, and extends about 1,000 yards, over which there are, at the shallowest part, 18½ feet water, the depth increasing rapidly to the west end of the Steam-Boat Quays at Port-Glasgow to 36 feet.

II.—*Observations regarding the Tides.*

On the 10th day of September last (1835), being the third day after full moon, blowing hard from the south west, with a little fresh in the river, the tide rose—

	Feet.	Inches.
At Port-Glasgow	10	2
At Garmoyle Light	10	0¾
At Bowling Bay	8	11½
At Renfrew	8	2½
At Glasgow	8	7½

Being a greater rise of 1¼ inch at Port-Glasgow than at Garmoyle; of 1 foot 2½ inches than at Bowling Bay; of 1 foot 11½ inches than at Renfrew; and of 1 foot 6½ inches than at the Broomielaw.

	H.	M.	
The time of high water at Port-Glasgow, was . . .	2	2	P.M.
,, ,, Garmoyle Light . . .	2	30	,,
,, ,, Bowling Bay . . .	2	43	,,
,, ,, Renfrew Ferry . . .	3	12	,,
,, ,, Broomielaw	3	50	,,

It being high water at Port-Glasgow 28 mins. sooner than at Garmoyle; 41 mins. sooner than at Bowling Bay; 1 hour 10 mins. sooner than at Renfrew Ferry; and 1 hour 48 mins. sooner than at the Broomielaw.

	H.	M.	
The time of low water at Port-Glasgow, was . . .	7	46	A.M.
,, ,, Garmoyle	8	15	,,
,, ,, Bowling Bay	9	14	,,
,, ,, Renfrew Ferry . . .	10	5	,,
,, ,, Broomielaw	10	41	,,

It being low water at Port-Glasgow 29 mins. sooner than at Garmoyle; 1 hour 28 mins. sooner than at Bowling Bay; 2 hours 19 mins. sooner than at Renfrew; and 2 hours 55 mins. sooner than at Glasgow. But, from a table of tides taken on the 1st, 2nd, and 3rd of November, 1834, blowing very hard from the N.W. (three days after new moon), it appears that the average rise of the above three days (comprising six tides), was—

	Feet.	Inches.
At Port-Glasgow	10	10
Garmoyle Light	9	9 3/10
Bowling Bay	8	0 1/10
Renfrew	6	4 1/10
Broomielaw	6	9 4/10

Being a greater rise at Port-Glasgow of 1 foot 7/10 inches than at Garmoyle Light; of 2 feet 9 9/10 inches than at Bowling Bay; of 4 feet 1 1/10 inches than at Renfrew Ferry; and of 4 feet 6/10 inches than at the Broomielaw.

From the average time of high water, taken from the same table, it appears that it was high water at Port-Glasgow 42 mins. sooner than at Garmoyle; 49 mins. 10 secs. sooner than at Bowling Bay; 1 hour 14 mins. 50 secs. sooner than at Renfrew; and 1 hour 42 mins. 50 secs. sooner than at the Broomielaw.

It also appears, from the average time of low water, taken as above, that it is low water at Port-Glasgow 42 mins. 40 secs. earlier than at Garmoyle; 1 hour 49 mins. 10 secs. earlier than at Bowling Bay; 2 hours 57 mins. 50 secs. earlier than at Renfrew Ferry; and 3 hours 30 mins. 50 secs. earlier than at Glasgow.

Neap tides rise about 4½ feet at the Broomielaw, and 7 feet at Port-Glasgow.

APPENDIX C.

GLASGOW.

No. 338.
Logan, on the Improvements in the River and Harbour, with Soundings and Borings.

III.—*Certain Principles to be kept in view as the foundation of future Proceedings.*

Whilst it is admitted that the rise and fall of the tide, and so the depth of the water in the fairway, must be affected considerably by the winds, freshes, and other circumstances, nevertheless we have enough to show that, in the present condition of the river, the class of merchant vessels drawing more than 12 feet water are compelled to discharge, and take in, cargoes at Greenock and Port-Glasgow, causing great expense and delay to the commerce at Glasgow; for, during the neap tides, there is not sufficient water for them, through at ordinary spring tides it will be seen that a depth of from 14 to 16 feet is attained.

In connexion with the deficiency of water just shown, we would beg attention to the following facts, regarding the draft of water of shipping:—Without entering into detail, we are safe in stating, that a large proportion of the vessels, engaged in foreign trade, require more depth than our river affords them; and, secondly, that the depth which we humbly propose to give the river; viz., 20 feet at high water of neap tides, will allow the free access of more than $\frac{9}{10}$ths of the shipping engaged in foreign trade; and, that in time of spring tides, the largest class of merchantmen in the United Kingdom may enter and depart the Broomielaw Harbour with perfect freedom, if the works which are here advised be completed. For, by Lloyd's List for the year 1833, there are only 33 vessels out of 10,430 that draw more than the depth proposed, and 5 of these 33 are of 600 tons burthen, and draw 20 feet water.

	Feet.
Fourteen are 700 tons burthen, and draw . .	20
Six are 800 tons, and draw	20
One of 900 tons draws	20
Two of 1000 tons draw	20

Again, there are only 4 of 700 tons that draw 21 feet, only one vessel of 800 tons drawing 22 feet water.

A leading principle in the improvement of the river, is to facilitate the flow of as great a body of water as possible, up from the sea; this is not only the source on which we depend for depth of water, but, when it has gone up in great quantities, it will acquire so much the greater power during its discharge or ebb, and so will tend materially to scour out and preserve the depth of the bed of the river.

On looking to the observations on the tides, it will be seen that the rise of the tide, as we ascend the river, decreases to a considerable, yet variable extent; this obviously depends on the irregularities of the bottom, and the opposition from the windings or projections.

The removal of the above irregularities of the bottom of the channel, will inevitably produce a fall of the low-water line; but it is equally obvious, that this will be much more than compensated for, by the deepening which is proposed, and the depth, even at low water, thereby rendered greater.

The present glacis along the banks of the river, where completed, are well constructed, and would, no doubt, answer every purpose they were intended for, while the river remained at a depth of 12 or 13 feet. The material with which they are formed is of a very small description of whinstone rubble, and, certainly, would not be sufficient to stand the extra pressure that will be brought to bear against the work from the bank behind, in the event of the channel being dredged to a greater depth.

IV.—*The Improvements which the foregoing Observations suggest.*

To secure the influx of tide, shown to be so important, it is obvious that every impediment that stands in the way of the tide's flow upward should be removed, and, with this view, the sections of certain portions of the river are recommended to widen and deepen the bed of the river, to remove projections and windings of its course, and add to its depth; with the same view, and on the same principle, I propose that the channel should gradually widen as it proceeds downwards:—

	Feet.
That from the west end of the Broomielaw Quay down to the Old Ferry at Renfrew, its width be made	300
From the Old Ferry, Renfrew, to opposite the intended quay for the use of the Renfrew and Paisley Railroad, it should increase to about	400
At the River Cart to	430
At Dalmuir Quay to	440
At Rashalee Quarry to	500
At Erskine Ferry to	540
At Donald's Quay to	590
Immediately to the east and west of the entrance lock to the Forth and Clyde Canal to	610
Dunglass Castle to	630
And opposite Dumbarton Castle to upwards of . . .	1200

There are various plans that might be suggested for securing the foundations of the rubble glacis, but the only two modes that I shall bring under your notice for the present, are—

1st. That a row of piles (home growth) be properly driven into the ground along the margin of the river, a short distance from each other, the tops to be brought to a level at the depth of 2 or 2½ feet under low-water line of the lowest tides, over which a longitudinal baulk is to be placed, and secured to the head of each pile, and at every alternate pile there be fixed a tye-bar of timber, placed transversely into the bank, the space between and behind the piles to be carefully filled in with small rubble-stone, until brought up to the level or top of the longitudinal baulk, and upon this the rubble glacis may be formed.

2nd. At the proper stage, when excavating the banks or projections of the river, I propose that large rough blocks of Whinstone rubble, of from 1 to 2 tons weight each, and intermixed with a smaller description, be thrown down on the exact line of foundation, so that while the operation of deepening the channel is going forward, these large masses of rock will sink, take their proper position, become consolidated, and, when the superincumbent weight is placed over them, and brought to a regular slope, the work will, no doubt, stand the pressure of the earth behind.

It is for this last mode I have made out my estimate. I give it the preference, because, whilst equally effective and stable, it is the less expensive, and may be done more expeditiously.

APPENDIX C.

GLASGOW.

No. 338.
Logan, on the Improvements in the River and Harbour, with Soundings and Borings.

V.—*Lastly, the Estimate of the Expense of executing the Improvements.*

The following estimate of the expense of executing the works suggested proceeds on the ground that the whole will be gone into; otherwise, of course, the estimate will depend upon, and must be modified by, the extent to which it is deemed proper to carry the improvements:—

My calculations issue in the following conclusions respecting the expense; viz.—

	£	s.	d.
For excavating, in cutting the north bank of the river to the breadth according to the line, as laid down on the map in red colour, from the west corner of the Broomielaw Quay to Dunglass Castle, 2,148,922$\frac{4}{5}$ cubic yards . . .	£80,584	11	11¼
For excavating the projections and additional width on the south bank of the river, from the east boundary of Mr. Todd's Cotton Mill to Dumbarton Rock, 2,343,827$\frac{7}{8}$ cubic yards	87,893	10	10
For dredging the channel, from the Broomielaw down to Dumbarton Castle, so as to have 20 feet water at high water of neap-tides, 3,020,160 cubic yards .	118,256	0	0
For constructing the rubble glacis on each side of the river, from the Broomielaw to Dumbarton Rock, 411,840 cubic yards of rubble-stone	61,776	0	0
Contingencies	34,357	0	0
	£377,867	2	9¼

Docks at Glasgow and at Nushat Isle, &c.

While the aforesaid works shall be in progress, additional accommodation for the increasing trade at the Broomielaw may also be procured, by extending the wharfs on both sides of the harbour westward, by a wet dock at the Windmillcroft, or on the north side of the harbour, as may be thought more advisable; and I take the liberty to lay before you a few detached sketches, to show how the several positions, pointed out on the map, can be made to answer, and to assist the Trust in choosing the situation most eligible, in all points of view, for this much-wanted accommodation.

I have also sketched on the map a dock at the west end of the Nushat Isle (a central position on the river), where vessels passing up or down, too late to reach their destination before the water fails them, may enter and be afloat, and so avoid the serious injury which often happens to large ships from getting aground. I propose that this dock should have an entrance to the east, and another to the west, laid down in a slanting direction from the channel of the river, so that tug-boats and their train of vessels may enter or depart with ease and freedom.

The bottom of the dock to be excavated, so as to have 20 feet water at low water of neap-tides.

The two entrances, and all the other boundary lines connected therewith, to be constructed with Whinstone embankment. According to the sketch laid down, the dimensions of this dock are in length upwards of 1200 feet; in breadth, 350 feet; and capable of holding merchantmen of the largest class. The detailed estimate for this improvement amounts to about 27,000*l.*

In executing the plan which I have laid down, each of its parts should be taken up with method, and in proper succession; and, as one step succeeds another, the advantages which attach to it, I trust, will become more and more apparent, until its completion, when the perfect facility of navigation, which the foregoing improvements must afford, will make the Broomielaw Harbour (once only able to admit the fisherman's boat), the commodious resort of the largest class of merchantmen,—facilitating commercial enterprize,—giving new impulse to every department of trade,—to the honour of the Trust,—and with benefits to the vast community, which, whilst all can see that they must be great, defy exact calculation, &c.

I have, &c.,
DAVID LOGAN.

ADDENDUM.

In consequence of the map of the river, above Broomielaw Bridge, having been put into my hands so recently, and, since that time, having been obliged to devote my whole attention to the subject matter of the foregoing Report, I have been prevented from examining the localities and other particulars, and from reporting in a way that could be satisfactory, on the navigation of the river upwards. But I shall immediately turn my undivided attention to this point, and report on it with the least possible delay. Some points of improvement on the upper navigation appear very obviously necessary, and may be laid before you. 1st. The Broomielaw Bridge being completed, the weir below it should be reduced in height, and the navigation continued, either through one or more of the arches, as far as the bridge at the foot of Stockwell-street; and a wharf wall should be built on the north bank of the river, from the bridge to the west end of the Town's Hospital property. This would prove a great convenience to the public, and to that quarter of the city, as boats, with provisions and other commodities, could reach this more central situation.

Besides, much of the inconvenience, arising from the numerous and large floats of timber which at present daily arrive, and very greatly incommode the harbour at the Broomielaw, might be obviated, by erecting a sufficient crane at this wharf, and making it the place for landing that material. Carting would thus be saved, and the injury to the streets thereby very much diminished; for a considerable proportion of the wood imported into Glasgow is carted to yards to the eastward of Stockwell-street.

To effect this improvement, a weir must be constructed on the lower side of the Stockwell-street Bridge, without which the proceedings intended would endanger that bridge's stability. The weir will also be required to maintain the present surface level of the water above the bridge, till such time as mature consideration be given to the improvements wanted further up.

By the Act 6th Geo. IV., passed 10th June, 1825 (but now expired), the surface level of the Clyde was not to be lowered; and to effect the improvements without this, a lock was to have been placed at the south end of the Broomielaw Bridge. Should this mode of improving the upper navigation be approved of again, the lock may now be placed at either of the ends of the Stockwell-street Bridge. And, in event of that bridge being rebuilt, and its piers founded at a sufficient depth, the upper navigation may be improved by deepening the shallows, and in every way encouraging the influx of the tide above the bridge.

To keep up the level of the Clyde, at the Water Companies' Works, a weir placed close to the Rutherglen Bridge, or higher up the river, would then become necessary.

I take the liberty of observing that, as Parliamentary enactments have conferred powers on the River Trustees as high up as the Stockwell-street Bridge, no delay need take place in carrying into effect the improvements suggested below that point.

D. L.

APPENDIX C.

GLASGOW.

No. 338.
Logan, on Improvements in the River and Harbour, with Soundings and Borings.

TABLE OF SOUNDINGS.

	Course generally taken by Vessels.		Middle of the River.				Course generally taken by Vessels.		Middle of the River.		
	Ft.	In.	Ft	In.			Ft.	In.	Ft.	In.	
0	14	2	13	4	Messrs. Barclay and Co.'s Slip Dock.	35	19	5¼	14	9½	Erskine Ferry.
						36	14	2¼	9	7¼	West St. Patrick's Stones.
1	14	2	13	7		37	14	4½	11	0¼	East of Donald's Quay.
2	17	5	17	4		38	13	4½	10	2¼	
3	14	4	13	3	Point House, Govan Ferry.	39	16	6½	13	9½	
4	12	11½	12	2½		40	14	5½	13	3½	Entrance Lock of Forth and Clyde Canal.
5	13	0½	11	11½							
6	13	11½	12	1½		41	16	10½	15	1½	
7	20	1½	17	6½		42	15	3½	12	6½	
8	14	2	13	10		43	16	2½	13	6¼	
9	13	9	12	3½		44	16	6½	15	0¼	
10	13	8	12	11		45	21	8¾	20	9¾	
11	16	2	13	7		46	28	6	21	9	Milton Isle.
12	15	0	13	3½		47	20	4	19	9	
13	13	9	13	8½		48	19	5	18	5	
14	14	11¾	12	8¼		49	19	1	18	2	
15	14	9	11	9½		50	18	2	18	1	
16	14	8	13	9	Renfrew Old Ferry.	51	16	3¾	15	5¾	
17	13	8½	12	7¼		52	16	0¾	14	9¾	
18	15	3	14	0		53	20	11	18	1	Dumbarton Rock.
19	14	0	13	8		54	23	9¾	20	3¾	
20	14	4½	12	5½	West boundary of Clyde Bank, the property of the Clyde Trustees.	55	22	7¾	20	10¾	
						56	24	4½	20	3½	
						57	22	10¾	22	10¾	East of Garmoyle Light.
21	13	9	13	7		58	23	7½	22	10½	
22	14	11½	13	8½	Barns of Clyde.	59	21	3½	20	3½	
23	15	7	15	0½	East of the River Cart.	60	19	7	19	7	
24	14	7½	13	10½		61	18	4	18	4	
25	14	9¾	13	0¼		62	19	0	18	6	
26	13	7½	11	4¾		63	26	3½	26	3½	
27	15	4¾	14	3¾	Centre of Nushat Isle.	64	30	6¼	27	6½	
28	16	0¾	14	11¾		65	26	6¼	26	3½	
29	20	6¾	14	3¾	Dalmuir Quay.	66	23	4½	22	4¼	
30	15	6	14	7		67	27	0¼	24	6½	
31	13	2	11	11	East of Rashalee Quarry Quay.	68	28	3½	25	7½	
						69	31	4½	31	4½	
32	15	4	12	9½		70	32	7½	32	7½	
33	13	10½	13	9½		71	36	0	36	0	West end of Steam-boat Quay, Port-Glasgow.
34	15	5	12	3							

TABLE OF BORINGS.

No.	Description.	Depth.		Remarks.
		Feet.	In.	
1	No. 2, Broomielaw Shed	7	0	5 feet at top, clean sand, and last 2 feet tough clay.
2	Foot of Robertson-street	6	0	6 do. do.
3	East Ferry, foot of York-street . . .	7	0	Close sand.
4	West Ferry	6	0	Soft mud.
5	Flagg Staff, west end, Broomielaw . .	7	0	Loose sand and gravel.
6	Mr. Napier's Dock	7	0	Loose gravel.
7	Greenlaw Fishing Shott	28	9	Sand.
8	Mavies' Bank	30	0	Do.
9	Messrs. Barclay and Co.'s Slip Dock .	6	0	Mud.
10	Mr. Houghhead's house	28	0	3 feet at top, loose fine gravel, and last 25 feet sand.
11	Stobcross House	7	0	Sand, slightly mixed with mud.
12	Stobcross West March	8	0	Loose sand.
13	Hornbank House	31	0	Sand.
14	Clyde Villa	32	0	
15	Heathery Hall	6	0	Soft muddy sand.
16	Watering-place, east of Messrs. Hunter and Co.'s Slip.	30	0	
17	Messrs. Hunter and Dow's Slip Dock .	6	0	Soft muddy sand.
18	Salterscroft	28	0	Muddy sand.
19	Mr. Rowand's property	25	0	Do.
20	Mr. Lockhead's do.	7	0	Loose sand.
21	Point-house Ferry Inn	22	0	Tough clay.
22	Govan Church	6	0	Muddy sand.
23	Govan Glebe	28	0	Do.
24	Mr. Thom's East March	27	0	Sand and gravel.
25	The Hayes Burn	30	0	Running mud.
26	Do. do.	7	0	Do.
27	The Fishing Draught, east of Crawford's Quay.	19	0	Very hard tough clay, mixed with large gravel. Made several attempts to bore about this place, but could get no deeper than 19 feet. Broke two augur screws.
28	Crawford's Quay	9	0	Soft running mud and sand.
20	John Auchie's Well	26	0	Running sand, mixed with gravel.
30	G. Rowan, Esq.'s east boundary . . .	8	0	1 foot fine gravel, and 7 feet running mud.

APPENDIX C.

GLASGOW.

No. 338.
Logan, on Improvements in the River and Harbour, with Soundings and Borings.

Table of Borings—*continued.*

No.	Description.	Depth.		Remarks.
		Feet.	In	
31	G. Rowan, Esq.'s west boundary	31	0	Running mud and sand.
32	Three-mile Burn	6	0	Do. do.
33	Hardgate Fishing Draught	7	0	Tough running mud.
34	East of the east boundary of Scotstown	20	0	Soft mud and sand, last foot hard clay.
35	West do. do.	19	0	Very tough mud and sand.
36	The lands of Easter Scotstown	6	0	Gravel and sand mixed.
37	Centre of the lands of Easter Scotstown	14	6	Tough clay and sand.
38	East boundary of Packmen's Isle	7	0	2 feet small gravel, and 5 feet mud and sand.
39	West do. Easter Scotstown	12	0	Very tough clay.
40	Do. do. Packman's Isle	7	0	Soft running mud.
41	East of the east boundary of Elderslie	32	0	8 feet mud, 12 feet sand, and 14 feet soft white mud.
42	Joppa Fishing Draught	7	0	Soft running mud.
43	West corner of Joppa Fishing Draught	12	0	Very hard clay.
44	West March of Scotstown	6	0	Hard black clay, mixed with small stones.
45	A. Speirs, Esq.'s East Watering-place	6	0	3 feet sand, and 3 feet hard white clay.
46	200 feet west of Renfrew Old Ferry	26	0	Soft white mud.
47	A. Spiers, Esq.'s West Watering-place	6	0	Do.
48	Pudzeoh	35	0	Do.
49	The Trustees' Dock, Clyde Bank	6	0	Do.
50	Harvey's Quay	8	0	7 feet 8 inches loose gravel, and last 4 inches clay.
51	400 feet east of Yoker Burn	35	0	29 feet sand and clay, and last 6 feet mud.
52	Logan's Hole Fishing Draught	7	9	Soft mud.
53	East end of the Barns of Clyde	28	0	Tough mud.
54	Barns of Clyde Gullet	7	0	8 inches loose gravel, and 0 feet 10 inches fine sand.
55	Renfield House	31	0	Fine sand.
56	A. Campbell, Esq.'s Watering-place	8	0	1 foot gravel, 2½ feet sand, and last 4½ feet sand an clay.
57	River Cart	7	0	Sand and mud.
58	West of River Cart	24	0	Soft sand.
59	Roan Fishing Draught	8	0	Loose sand and gravel.
60	East of the lands of Dalmuir	24	6	Soft sand.
01	Barns of Clyde, west boundary	7	0	Mud and sand.
02	Brick-house Ferry	29	6	Loose gravel and mud.
63	Do. do.	7	0	Do.
61	First Perch, south side west of Brick-house Ferry.	30	0	Black muddy sand.
65	Standy-lane Perch	8	0	Mud and sand.
66	Centre of Nushat Isle	26	0	Hard clay, mixed with gravel.
67	Fluck-hole Fishing Draught	8	0	Close sand and mud.
68	West of do.	26	0	20 feet black sand, and 6 feet tough clay.
69	400 feet east of Dalmuir Quay	27	0	Sand.
70	Dalmuir Quay	8	0	Do.
71	Fishing Draught, west of do.	27	0	Do.
72	Miss Fulton's Quay	0	0	2 feet loose gravel, and 7 feet hard sand.
73	400 feet west of do.	20	0	Clay and sand.
74	100 feet east of Rashalee Quarry Quay	12	0	Very hard red clay, mixed with large gravel.
75	Rashalee Quarry Quay	9	0	4 feet loose sand, and 5 feet do.
76	East of the March between Dalmuir and Dalnottar.	12	0	Very hard red clay, mixed with large gravel. Broke the augur screw.
77	West of do. do.	16	0	Sand and hard red clay.
78	North-barr House	8	0	Close sand and gravel.
79	Castle Porridge	9	0	Very hard clay, mixed with large gravel and stones.
80	20 feet west of Castle Porridge	7	0	Do. do.
81	100 feet farther west	18	0	Do. do.
82	Dalnottar House	9	0	Clean sandy bottom.
63	East end of Bottombow Island	11	0	Very tough red clay.
84	Erskine Ferry	9	0	Clean sand.
85	Dalnottar Iron Works	20	0	Sand.
86	St. Patrick's Stone	8	0	Soft mud and sand.
87	400 feet west of do.	23	0	Black sand and clay.
68	No. 2 Jetty above Ferry Dyke	8	0	Sand.
89	No. 1, Jetty above Ferry Dyke	14	0	Hard sand and clay.
90	Ferry Dyke Coal Wharf	6	0	2 feet gravel, and last 6 feet sand.
91	750 feet west of do.	15	0	Hard red clay.
92	600 feet west of Last Bore	25	0	Clay and sand.
93	The Black Bush	10	0	Sand.
94	610 feet east of Bowling Bay Lock	25	0	Do.
95	Bowling Bay Entrance Lock	6	0	Do.
86	The Dyke	8	0	6 feet sand, and last 2 feet soft mud.
97	Frisky House	8	0	Sand
98	Auchintorlie House	9	0	Do.
99	Dunglass Castle	9	0	4 feet soft sand, and 5 feet hard gravel.
100	Mavies' Bank	7	6	Sand.
101	East Longoch Perch	7	6	Sand and gravel.
102	West do.	7	6	Mud.
103	First Barrel Perch on Long Dyke	8	0	Mud and sand.
104	Milton's Isle	11	6	Sand.
105	Dumbuck Perch	9	0	Do.
106	M'Rabb's Perch	13	0	Soft mud.
107	Barrel Perch, end of Long Dyke	9	6	Sand.
108	North Pettyroy Perch	9	0	Hard Sand.
109	Pettyroy Perch	14	6	Mud and sand.
110	Between Keep North Perch and Large Barrel Perch Foot of Long Dyke.	11	0	Do.
111	Guard-house Perch	19	0	Soft mud.
112	Leven Perch	13	0	Soft mud and sand.
113	Dumbarton Glass Work	13	0	Sand.
114	Leven Grove Quarry	13	0	Do.
115	West of do.	11	0	Sand and mud.
116	Garmoyle Light	9	0	Do.
117	Findlayson's East Porter Lodge	9	0	Do.

No. 339.

Report by JAMES WALKER, Esq., F.R.S., L. and E., *to the Parliamentary Trustees for Improving the Navigation of the River Clyde, and enlarging the Harbour of Glasgow.*

No. 339.
Walker, on proposed Improvements in the River and Harbour.

GENTLEMEN, *Great George Street, Westminster, February* 11, 1836.

BY your resolution of the 21st of October last, the engineer to be appointed by you is "requested to visit Glasgow for the purpose of inspecting the river Clyde and its survey, in connexion with the plans of Mr. Logan, and to report his opinion fully thereon:" I have since had the honour of being so appointed, and of having the reference extended by the resolution of the 19th of November, which requests me not to confine myself to Mr. Logan's plans, but "to consider generally as to the best means of promoting the trade of Glasgow, whether by improving the river Clyde, or by forming a canal, canals, or otherwise."

In compliance with the above, I visited Glasgow in October last, when I found an excellent survey of the river and harbour by Mr. Kyle, upon which Mr. Logan had laid down lines for a proposed enlargement, deepening, and straightening, and also for docks, and had fully reported on the subject. On that occasion I accompanied Mr. Logan and Mr. Gibb down the river to the extent of the proposed improvements, and likewise up as far as Dalmarnock Bridge, about half a mile above Rutherglen Quay. I also examined and advised as to the sites that appeared to me to have the greatest advantages; considered the plans prepared by Mr. Logan; suggested such alterations as I deemed advisable; and settled with him the dock and river lines to be deposited, preparatory to the application to Parliament; but as no surveys had been made with reference to the project of a canal that had been suggested, nor such details taken as were required to estimate the docks and form an opinion of the effects of the intended deepening of the river, I gave directions for these, and recommended to the meeting of your body which I attended, to give the Parliamentary notices, and to lodge the deposits for the river and dock improvements as finally agreed on by Mr. Logan and me, and approved of by you—which has been done. There was not time, supposing it otherwise advisable, to include the canal in the notices, but I directed surveys to be made for this, and on my return to London, sent, at Mr. Logan's request, Mr. Comrie, a surveyor of great experience and accuracy, to assist in forwarding the surveys.

About the middle of January, I again visited Glasgow, surveyed the line thought best for a canal from above Bowling Bay to the Broomielaw, as well as the mills upon the river Kelvin that would be affected. As, however, the borings and some other details were not then complete, I have been obliged to postpone the final estimates, but think better not longer to delay my opinion on the important points referred to me, as it may in some measure affect your directions for Parliamentary proceedings.

It would be improper, in advising as to the kind and degree of future improvement, not to refer to the past, and in doing so, we find encouragement, from the success generally that has attended the operations, and from the great increase of trade that has been the consequence. The tonnage and harbour duties for the year 1771, were 1071*l.*; in 1791, they were 2145*l.*; in 1804, 4760*l.*; in 1815, 5960*l.*; in 1825, 8408*l.*; in 1826, (when 33 per cent. was added to the rates,) they were 16,200*l.*; in 1835, they were 31,900*l.*; * and the present year is likely to show a continued increase.

This rapid increase has been in a great degree contemporaneous with the improvements of the river; its capabilities having been increased in nearly the same proportions as the revenue. In 1755, Smeaton, whose reputation as an engineer has not been excelled, reported that the depth of the river was sufficient at high water of neap tides for vessels drawing not more than 4 feet 6 inches, as far up as Spoydock Shoal, and recommended the constructing of a lock at Marlinford, and a dam or weir, by means of which the same depth (4 feet 6 inches) might be secured up to the quay at Glasgow; and in 1759, an Act was passed for carrying his plan into effect, the above depth being all that was then judged practicable. Smeaton states, that at that time the ordinary neap tides were sensible at Glasgow Bridge. It is unnecessary to inform you that, fortunately, his proposal was not acted on,—the plan of removing the shoals, and contracting the width of the channel without lock or weir, as first recommended by Golborne in 1768, was adopted,—and that this having been pursued by the trustees, there is now at Broomielaw from 7 to 8 feet at low water, while the lift of a neap tide at Glasgow Bridge, which was only sensible in 1755, is 4 feet, and of a spring tide 7 or 8 feet, making 12 feet depth at high water of a neap and 15 feet of a spring tide; so that the river which, by artificial means, was to be rendered capable of taking craft of about 30 or 40 tons to Glasgow, has, by what Golborne calls "assisting Nature," been rendered capable of floating vessels of nearly ten times the burthen.

While following up the system that has hitherto proved so successful, I think the trustees have done wisely in having such plans and designs laid before them as may enable them to take a general and extensive view of the important question in reference to the greatest capability of the river, or of navigation, by the present, or any other means, so that improvements, though partial, may be made to accord with, and form part of, a greater whole, in place of being useless, or perhaps, opposed to it. For the same reason, the plan of a ship canal has been very properly suggested, not perhaps so much from any confident opinion being entertained of its superseding the improvement of the river as from the feeling that the present is the time when all schemes, having any argument in their favour, ought to be well considered before you finally resolve and act upon one which might possibly, when too late, be discovered not to have been the best.

The ship canal has been proposed to enter from the north side of the river above Bowling Bay, to be continued on the low grounds up to Glasgow, and there to terminate in docks, the level of the canal and docks being kept above that of the river by means of locking. One of your members Baillie Johnston, who has given great attention to this particular subject, considers the main object of the canal to be the accommodation of heavy vessels engaged in foreign trade, and that a depth of 20 feet, with a bottom width of 60 feet, would be ample; that a lock suited for this description of vessels would be sufficient; and that steamers which require a greater width and a larger lock should continue to use the river.

I stated the objections, as they appeared to me, to a plan, which, in the present growing trade by

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* 1835 exceeds 1834 by nearly 10,000*l.* This is partly to be accounted for by the trustees resuming the collection of the dues, which had been let to tacksmen during the preceding ten years.

APPENDIX C

GLASGOW.

No. 339.
Walker, on proposed Improvements in the River and Harbour.

steam, would not admit the largest class of steam-boats;—the principal is, that the river would still require to be made and kept of sufficient depth for this description of vessels at the high water or low tides, and that as the size or draught of steamers, as well as their number, is on the increase, the formation of a canal, on this limited plan, would not supersede the deepening of the river to within but a little of all that would be requisite if the canal were not made, thus incurring something like a double expenditure. There would also, no doubt, be objections to taking steam-vessels through a canal into a dock, from the delay; and as the expense of money and of water would be much increased by thus enlarging the plan, I have considered the canal and docks as to be formed for sailing vessels, but not for large steamers.

The result of the levels and surveys I have taken for the canal plan is favourable, as respects the level of the ground, which averages about 6 feet above high water of neap tides. Donald's Quay, half a mile above Bowling Bay, appears the best place for entering. The principal ornamental ground, or park, in the line, is Scotstown, the residence of Miss Oswald, which would necessarily be injured; there is no other of much importance; so that, considering the length of the canal, and the situation, being upon the river and so near the city, the line is also favourable as respects non-interference with seats. As the site of the proposed docks on the north side of the river is considerably above high water, the expense of forming them would be lessened by the water being above the level of the tides, which would be the case on the canal plan, and this level would also be more suitable for the quays to communicate with the streets in the town.

In point of engineering, the crossing of the river Kelvin would be the work of the greatest difficulty. I have given this subject some consideration. One way is, to carry the canal in an aqueduct and the Kelvin under it; if so, the clear height of water way could not, I think, be less than the high water of the tide, and even this would require a great width to pass the flood-waters, which sometimes rise 10 or 11 feet above the tide level. Thus the bottom of the aqueduct or canal could not be less than from 2 to 3 feet above the level of the tide, and with a depth of 20 feet in the canal, the surface water would be 22 feet above the tide. There are other minor streams to be crossed, but none equal to the Kelvin, which must be allowed to be rather a formidable matter.

An evil arising from the height being so great, as I have described, is the consumption of water for lockage. The main supply must be from the Kelvin, unless pumping from the Clyde by a steam-engine be resorted to. I had conversations with Mr. Grahame and others as to the water likely to be had from the Forth and Clyde Canal; if the proposed canal were not above the level of the basin at Bowling Bay, which is 8 to 10 feet above high water in the river, some water might be had from it; but if it were above that level, I think this supply could not be depended upon, for although to be sure last year was the first time the Canal Company were short of water at this end, and although they intend to add to their present reservoirs to meet their increasing trade, I think it would be difficult to get them to bind themselves; and without this it would be wrong to depend on their assistance. The supply from the Kelvin becomes, therefore, a principal subject for attention. If the water were kept up to the level I have stated, it would be necessary to take it from the head of the very fine mills at Partick, belonging to the Corporation of Bakers of Glasgow, which would involve the purchase of part of the water-power of these mills at all times, excepting during freshes, and the whole of such power during droughts, as, at these times, the entire supply of the river and reservoir is not much more than half a lock per hour, supposing the whole lift of 20 feet to be in one lock, or one lock per hour, if the 20 feet be attained by two lifts of 10 feet each, one at the entrance of the canal, the other, as suggested by Mr. Comrie, before crossing the Kelvin; but in severe droughts the river does not yield much more than half this quantity. The mills would be best compensated by adding to the steam-power; though from their peculiar history,* and antiquity, there might be some difficulty. The flour mills below would also have to be purchased, but they are of less value, two of them of very little.

If, again, the canal were kept down to 8 or 10 feet above the tide, the Baker Company's Mills would not be affected, but the flood-waters of the Kelvin would by this plan have to be passed into, and across the canal, which would be attended with inconvenience, equal perhaps on the whole to the other scheme.

This limited supply of water is a strong argument in favour of confining the canal to sailing vessels, as from the greater number of lockings and larger size of locks that would be required for steamers, much more water would be necessary, for which the Kelvin appears to be quite inadequate; even with sailing vessels only, there might be an occasional want if the trade were at all great.

Without more detailed plans, an accurate estimate cannot be expected. The figures I have thrown together from measurements and levels make from 150,000*l.* to 200,000*l.*, exclusive of purchases and compensations, which would be considerable.

After the best consideration I have been able to apply to the question, my decided opinion is, that, at present, a canal, in any of the ways I have described, would not be advisable—that it would be in some respects analogous to the plan which was suggested by Smeaton in 1755—and that the better way is to continue the system afterwards recommended by Golborne, and hitherto so successfully followed, of regulating the width, and adding to the depth by the removal of the hard matter which still in part forms the shoals, and by dredging, to an increased depth, where this may be required.

The argument I before referred to appears almost to be conclusive. Some heavy steamers draw 14 feet; the trade by steam is increasing, and also the size of the vessels, many of them are of a sharp or fine build, and their grounding when loaded being injurious, they should at least be water-borne as much as possible.

The canal plan is not intended to supersede the improvement of the river for the convenience of this description of vessels; and probably 15 feet at high water at neap, or 18 feet at that of spring tides, is as little as would completely answer the purpose of steamers. Now 4 or 5 feet more would do well for sailing vessels, and this addition would, at the same time, give still more convenience and facility to steamers, by making the river navigable for them at nearly all times of tide, and enabling them, from the greater depth of water, to lie more easily in the harbour. The river improvement, it is, therefore, agreed on all hands should be executed; and the question is, should the canal be now resolved on also? I think not; for although there are advantages which I have described, there are also difficulties, and the latter are such as require the proof of necessity for a canal, in order to justify its being undertaken, and I do not think such necessity can be shown at present, as it appears to me that the accommodation for the increasing trade of the port will be very amply provided for by the improvements in the river and harbour and the formation of docks as projected, without the construction of a canal, which would be chiefly an additional expense.

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* These mills were a grant from the Crown to the Corporation of Bakers, in 1568.—*Cleland.*

It is to the river, therefore, that my attention is now to be devoted.

No. 339.
Walker, on proposed Improvements in the River and Harbour.

Mr. Logan's report and plans, giving a minute detail of the present and proposed state of the Clyde, having been printed, supersedes the necessity of repetition by me. His river lines appear to be laid down judiciously; I have proposed some, but no very material, alterations in them. The design is sufficiently extensive, as a maximum, which is the safe course in applying to Parliament, if the funds will justify it. The plan proposes a width of 300 feet from Broomielaw to above Renfrew Ferry, whence to the river Cart it widens to from 400 to 430, then to Dalmuir Quay 440, to Rashleigh Quarry 500, to Erskine Ferry 540, to Donald's Quay 590, to Bowling Bay 600, and to Dunglass Castle 630, the depth being almost uniformly 20 feet with high water of neap tides.

It may be doubtful if this increased sectional area, nearly level, can be maintained without dredging, probably not, although, referring again to experience, the section has already been much enlarged by artificial means, yet the work of support is not considerable. The hard shoals having been removed by dredging, the soft matter is carried off by the current, assisted by the steamers, and the river keeps itself clear. Mr. Logan informs me that these shoals require still more to be deepened, and he expects, justly, I think, that the operation of natural deepening will be continued where the ground is soft; the straightening of the river will also tend to this by increasing the velocity of the current, and, besides, the deposit from the water of the Clyde does not appear to be great. In a small dock or recess which has been open some ten years, and is quite out of the stream, there is but little mud; the proprietor, Mr. Napier, had not been particular in observing, but did not think it exceeded an inch or two in a year.

In the execution of this great work, it is, however, not unlikely that some partial alterations from the plan now laid down may be expedient. The chief one I have at present recommended is at the lower end or opening of the estuary, near Dumbarton, with a view of preventing a diminution of tidal water, which might be the effect of carrying the side banks above the tide; and therefore I propose still to confine the current in the proper channel by means of banks, but these not higher than half tide level, and to have beacons of sufficient height placed at intervals as guides, when the water shall be over the banks.

As a general question, there can, I think, be no doubt as to the proposed enlargement being beneficial, not only by giving much additional facility for shipping, but by improving the great drain of the country, and so preventing the river from overflowing the low lands near it, and (which I take to be very important) by lessening or entirely doing away with the flooding of the low parts of Glasgow, and the quays at the Broomielaw.

On my first visit I had the opportunity of witnessing the effects of a fresh. After a heavy rain on the 21st of October, the river at the Broomielaw on the following morning rose 9 feet 4 inches* above the high water level of average neap tides, and, at the time of tidal low-water, it was still more than 7 feet lower. If, therefore, the fall of the tide be added, there must have been a difference of level of 18 feet in the surface of the water from the Broomielaw to above Dumbarton, say, in a length of 12 to 14 miles—the inclination being greatest in the upper part, or near Glasgow. As the rain which fell when the water was thus high in the Clyde could not pass into the river, it rose in the cellars and houses of several streets in the city, and it was 3 feet deep in the landing sheds upon the quays, so that everything had been removed out of them during the night into the ways and streets—the appearance in the morning was deplorable. The low grounds also, particularly above and below Renfrew, were overflowed to a considerable extent. Unquestionably the straightening and enlarging of the river, and the improvements hereafter stated, will do much towards the removal of all these evils; if it should reduce the rise of such a fresh as that of the 22nd of October, from 9 feet 4 inches to 4 feet, which may, I think, be depended upon, the benefit would be alike important to the city and to the low lands down the river, for further securing which the banks or dykes should be raised above the highest tide, so as to confine the river to its natural channel, as the Thames is below London Bridge, where the lands, though 6 feet under spring-tides, are never flooded. By thus keeping the river within its proper bounds, the scouring of the bottom will be assisted by the increased rapidity of the stream, as it has already been wherever the current has been so confined; the land, if the dykes be properly formed, will be improved in value and also in beauty, and the excavated soil may thus at the same time be deposited cheaply and usefully.

The sides of the river are proposed to be paved with rough rubble-stone dykes, as described by Mr. Logan in his Report. There seemed an idea with some members of the trust that deepening would be sufficient, and that the stone facing, which is expensive, is unnecessary. It would be so if the soil composing the sides were of so firm a nature as not to be moved by the current, and if thus the proper width could be preserved; but this is not the case, and therefore any attempt to narrow or deepen without securing the sides with heavy material would be useless. The land-floods would undermine the banks, which would fall in, the river would widen, and be irregular and shifting, and shoals would form as before; whereas, by confining the sides by a material which is more difficult to move, the soil of the bottom gives way to the increased velocity which is the natural effect of the narrowing, from the water working to obtain in depth what it finds it cannot in width. I am aware that a very different opinion has been expressed by the late Mr. Whidbey, a highly respectable authority, on many points, but not superior to Golborne, Rennie, and Telford, who all thought differently. Mr. Whidbey's opinion appears to have been founded upon the idea that the Clyde up to Glasgow depends chiefly upon the tide. I think otherwise, and that the sectional area of the river, nearly as far down as dredging is wanted, is caused by, or is the effect of, the land-floods, much more than of the tide-water. I do not say that the latter is useless, or that it ought not to be encouraged, but only that, comparatively, it is of less consequence for scour than the land-waters. I believe that the velocity of an ebbing tide may be taken at a mile and a half an hour near the harbour. Now the fresh I saw ran four and a half miles per hour, and at that time it had subsided 2 feet from the height at which it had been during the night. Evidently such a scour must have much greater effect than the tidal current of a third the velocity, and if this be not sufficient proof of the soundness of the plans that have been pursued, it is not necessary to go to other rivers for illustration, although there are

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* This was 5 feet 6 inches lower than the great flood of 1782.

APPENDIX C.

GLASGOW.

No. 339.
Walker, on proposed Improvements in the River and Harbour.

many, but only to compare the Clyde, as it is, with the Clyde as it was before the operations began when the tide had its full range of width.* Lower down the river, near Dumbarton, where the river is wider, the land-floods become unimportant, as compared with the tides, and therefore it is that the tide ought to be the chief object of care, and that I have recommended the dykes being kept down so as to prevent as much as possible a diminution of the tidal water.

The proposed widening up to Glasgow will increase the tidal receptacle or reservoir, and therefore tend to improve all the lower part of the river that depends upon the tide for its depth.

Wet Docks.

The subject next in importance is Docks, without which there might, notwithstanding the addition now making to the width of the harbour, be the objection, that, providing great depths for heavy ships is doing but half the work, if they are to be subject to ground when the tide retires; and I agree with Mr. Logan that the tendency of straightening and cleansing the river will be rather to reduce the low water level at the Broomielaw.

Three sites have been proposed for docks, viz., two on the north and one on the south side; of these I think that on the south, on the whole, the most desirable to commence with; it extends from New Bridge-street down to Mr. Tod's factory, and is bounded on the south by King-street, being a quadrangle of which the entirely vacant ground called "Windmillcroft" forms about a half. This will give room for two docks of (together) 15 acres, or accommodation for 150 ships, with quays all round, and a space for the Govan and Pollock Railway between. The entrance lock is proposed to be 200 feet long by 60 feet wide, so as to admit the largest steamers; the depth to be 20 feet at high water of neap tides.

The time for proceeding with further dock room will naturally depend upon circumstances, but, after the above, I consider the situation next in order would be the Lancefield property, on the north side of the river, extending from Finnieston-street to Warwick-street, for docks, and for which a plan has also been prepared, giving an area of 16 acres of floating surface with spacious quays. The principal land entrance by this plan is designed as a continuation of Argyle-street, for which some buildings in Stobcross-street would require to be taken down; but the communication would be convenient for town trade, and, with a proper gateway, would form a good termination to one of the finest streets in the kingdom. With the improved harbour, it may be some time before docks be required on this side, but the ground is not likely to be purchased hereafter at so reasonable a rate as at present, when a great part of it is vacant.

Another situation that has been proposed for a dock, on the north side, is to the eastward of the above, extending from MacAlpin-street to York-street; this I consider inferior to the others from the area being small, the levels high, the buildings expensive, and the space near the river being occupied already as quays and for other shipping purposes.

The great extent of frontage on the north side of the river, between the New Bridge and Stockwell-street Bridge is at present entirely useless and unoccupied. I was told that possession of the whole for public purposes may be resumed for 4500*l.*; it might be used to great advantage as a quay for market boats and other small vessels from its proximity to the body of the city.

Power to open the river above the Broomielaw for navigation is proposed to be applied for. To effect this, the weir below the New Bridge must be lowered, and the depth of the foundations is such that it can be done without danger to that handsome structure—the last work of Telford. The removal of this weir, and the deepening above it that will be the consequence, will form another important addition to the reservoir for tidal water, as every tide will ebb several feet lower than it does at present.

I am informed that Stockwell-street Bridge is the only one of which the foundations are not low enough to prevent danger by the deepening of the river. Either, therefore, a new bridge will be required here, or if it be thought better to support the present fabric, the piers must be piled round as has been requisite at Blackfriars Bridge in London, from a similar cause, viz., the removal of the dam or weir of Old London Bridge.

If the effect of all or any of the works above referred to be found injurious to the water works, by lowering the level of the river, there will be no difficulty in applying a preventive.

I remarked that the river immediately below Rutherglen Quay is injuriously contracted by the embankment of the Cranston Hill water-works on the one side, and Mr. Whyte's walls and buildings on the other; also that a great quantity of ashes had been thrown out from Mr. Whyte's premises, apparently to be washed away by the first fresh. Such encroachments ought to be carefully prevented.

To enable me to report on the question of the navigation between Rutherglen and Carmyle requires much consideration and more knowledge of detail than I possess. The river here is so extremely tortuous for navigation; that before expending money upon it, the conveyance by means of railways, and the bearings of each mode upon the particular trades and places must be fully considered. The field for improvement between Rutherglen and Dumbarton is sufficiently extensive for present operations, and there can be no doubt that if these be successfully executed to, or nearly to, the extent that has been detailed, Glasgow will, in point of safety and extent of accommodation for shipping, be inferior to very few ports in this kingdom.

I am, &c.,
JAMES WALKER.

No. 340.

No. 340.
Russell, on the Tidal Wave of the Clyde, the state of the Channel, and the Improvement of the Navigation, with Table of Tides.

Report of Observations on the Tidal Wave of the River Clyde; with Remarks on the State of the Channel and the Improvement of the Navigation, by JOHN SCOTT RUSSELL., M.A., F.R.S.E., &c.

GENTLEMEN,

21, *Coates Crescent, Edinburgh, Jan.* 1838.

IN the spring of this year application was made by Sir Thomas Brisbane, Bart., President of the Royal Society of Edinburgh, and formerly President of the British Association for the Advancement of Science, through the politeness of Baillie Bankier, to the Honourable Board of Trustees of the River Clyde, to obtain their assistance and co-operation in making a series of observations on the tides of the Frith of Clyde, which had been intrusted to Sir John Robison, K.H., Secretary of the

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* Forming pools and islands which caused the most skilful skipper to miss the channel.

APPENDIX C.

GLASGOW.

No. 340.
Russell, on the Tidal Wave of the Clyde, the state of the Channel, and the Improvement of the Navigation, with Table of Tides.

Royal Society, and to myself, by the British Association. This application having been readily and cordially responded to, as likely to conduce to the advancement of the interests of science and of navigation generally, and to throw light upon the condition and prospects of the navigation of the river Clyde, in which the trustees are so immediately concerned, I was at once placed in communication with Mr. Logan, the engineer of the trust, by whose talents, experience, and accurate knowledge of the nature of fluids, and of the state of the river Clyde, I was materially assisted; and we determined that the experiments and observations should be conducted in such a manner as should not merely accomplish the scientific object which I had more immediately in view, but should also contribute as much benefit to the interests of the trust and of the river as could be derived from a correct series of tidal observations, conducted with scientific accuracy, and under the care of one who was to devote his undivided attention to the subject. Mr. Logan considered that, by keeping in view the interests of the river, the objects of the trust might thus be materially promoted. Measures were accordingly taken to make the observations bear as much as possible on the improvement of the river. Simultaneous tide observations were made at nine different stations every five minutes, which began on the 20th of April, and ended on the 12th of May.* Correct geometrical levels were run by Mr. Kyle, with great accuracy from the Broomielaw to Port-Glasgow. Captain Denham, R.N., the surveyor of the port of Liverpool, was good enough, at my request, to institute observations at the same time at the Liverpool Docks, for the purpose of establishing the relative times and heights of the tide at the two great ports of Liverpool and Glasgow, between which so much intercourse is now carried on by the finest steam-vessels in the world; and, at the request of Mr. Logan, similar observations were made at other harbours on the coast of the Irish Sea, viz., Whitehaven, Donaghadee, Port-Patrick, Port-Rush, and Newry. Professor Nicol was kind enough to allow me the use of the College Observatory, for determining time, and for meteorological observations; and I was personally engaged, during the month of April and part of May, in superintending the necessary arrangements, and connecting the observations with each other.

I have now great pleasure in discharging the duty I have undertaken of communicating to the trustees, as fully as possible, the results of these observations, inasfar as they appear to bear upon the subject of the improvement of their noble river. I would have done so earlier, but up to this moment I had not been able to complete the numerous complicated calculations which were necessary to bring out the results.

I shall arrange the subject under the following different heads: —

Present State of the Tides.

Height of the tide.
Time of high water.
Influence of the wind.

Means of farther Improvement.

Dimensions of the channel.
Formation of the banks.
Effects of steam navigation.

Present State of the Tides.

1. *Height of the Tides.*—The observations on the height of the tides are made upon a level line 20 feet below the summit of the granite coping of the new quay wall, on the south side of the harbour at the Broomielaw.

This level line was carried from the harbour at Glasgow to the harbour at Port-Glasgow, a distance of more than 18 miles, with great precision and accuracy, by that excellent surveyor, Mr. Kyle; and he was directed to take permanent marks all the way down the river, so that, at any future period, the changes of the fresh-water surface, of the height of the tides, and the condition of the channel, may be accurately determined and compared with what they are now. It is conceived that a careful comparison of tide observations will, in future, become an object of considerable importance to the trustees, as the best mode of showing the effects which are produced by their operations, and which may furnish more grounds for future proceedings.

It is firmly established, by these observations, that in consequence of the improvements already made on the river, the tide does, in fact, rise higher at the Broomielaw than at Port-Glasgow, and that the low water does not fall nearly so low at the former as at Port-Glasgow and Greenock. The top of high water rises generally 10½ inches higher at Glasgow than at Port-Glasgow; and this change of level is attended with a gradual increase in the height of high water all the way up the river. From Port-Glasgow to Garmoyle this increase amounts to 2 inches; at Bowling it becomes 5¼ inches; at Clyde Bank it is 6¼ inches higher than at Port-Glasgow, and continues to rise in a regular slope to the Broomielaw, where it becomes 10½ inches. At neap tides this effect is diminished an inch or two, and at spring tides it is increased to more than a foot.

It should also be observed, that at low water the surface of the river is much higher at Glasgow than at Port-Glasgow. In its ordinary state, the river is 2 feet 9 inches higher at the Broomielaw than at Port-Glasgow, but during freshes on the river this difference often amounts to a very great quantity. Low water at Garmoyle is about an inch higher than at Port-Glasgow. At Bowling it rises suddenly a foot; at Rashalee pier 6 inches more; at Clyde Bank it becomes about 2 feet, and gains 9 inches more on reaching the Broomielaw. This is important, for it shows that, if the river below Bowling were made of the proper width, there would be a considerable increase of depth obtained as far as Garmoyle; whereas at present the surface of the river below Dunglass is suddenly lowered about a foot, by the great widening of the channel.

Spring tides, as has been observed by Mr. Logan in his former observations, rise and fall about 11 feet at Port-Glasgow, and about 7 feet at the Broomielaw; while neaps rise about 6 feet at Port-Glasgow, and 4½ at the Broomielaw.

2. *Time of High Water.*—The observations were all reduced to mean solar time on the meridian of the Observatory of the Glasgow University, the use of which was kindly granted by Professor

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* For Abstract of Tide Observations, see Table at the end.

APPENDIX C.

GLASGOW.

No. 340.
Russell, on the Tidal Wave of the Clyde, the state of the Channel, and the Improvement of the Navigation, with Table of Tides.

Nicol. It appears, from the observations made during April and May last, that the times of high water, compared with Port-Glasgow, are as follows:—

At Cloch Light high water is	9	minutes earlier	than at Port-Glasgow.
Lazaretto Point . .	5	,,	,,
Cumbrae Light-house .	15	,,	,,
Port Patrick . .	31	,,	,,
Liverpool . . .	51	,,	,,
Whitehaven . .	62	,,	,,
Newry . . .	85	,,	,,
Donagbadee . .	127	,,	,,
Port Rush . .	5 h. 35	,,	,,

At Garmoyle Light H. W. is	6	minutes later	than at Port-Glasgow.
Bowling . . .	24	,,	,,
Rashalee . . .	43	,,	,,
Clyde Bank . .	61	,,	,,
Crawford's Quay .	76	,,	,,
Broomielaw . .	83	,,	,,

Being 1 hour 23 minutes between Port-Glasgow and the Broomielaw.

The tide begins to rise from low water towards high water about an hour and a half earlier at Port-Glasgow than at Bowling. When it has risen about a foot at Port-Glasgow, it begins to rise at Bowling. An hour afterwards it begins to rise at Clyde Bank, and has already risen 2 feet 8 inches at Port-Glasgow, and 1 foot at Bowling. In another hour flood tide reaches Glasgow, and begins to rise at the Broomielaw; while in the mean time the water has risen 4 feet at Port Glasgow, 1 foot 10 inches at Bowling, and 9 inches at Clyde Bank. When high water has reached Port-Glasgow it still wants 1 foot of high water at Bowling, 1 foot 8 inches at Clyde Bank, and 2 feet 4 inches at the Broomielaw. And by the time high water has reached the Broomielaw it has already fallen away 1 foot 5 inches at Port-Glasgow, 7 inches at Bowling, and 3½ inches at Clyde Bank.

About half-tide the water rises at the rate of about 1 foot 9 inches per hour.

The tide ebbs seldom faster than 1 foot per hour.

At Clyde Bank the tide is rising about 5 hours, and falling more than 7 hours.

These observations will enable us to form much more correct and minute tide-tables for Glasgow and places in the Frith of Clyde and its vicinity than have existed heretofore. The necessary calculations for these tables are now in progress.

3. *Effect of Wind on the Tide.*—I made the effect of wind upon the tide the subject of careful observation. On the distance between the Cloch Light-house and Glasgow, being only 25 miles, the wind when blowing a strong breeze from the east, makes the tide between 2 and 3 feet lower at the Broomielaw than if it blew equally from the west. In the case of a violent gale this effect would probably be nearly doubled.

No breeze which was observed was so violent as to produce a decided effect on the time of high water. Long-continued observations can alone decide this important point.

I now proceed to communicate to the Trustees of the Clyde all the suggestions which my observations on the Clyde or elsewhere enable me to make for the improvement of that noble river, on the banks of which I was born, and in the improvement of which, and in all that concerns the welfare of Clydesdale, I take a deep and heartfelt interest.

Future Improvement of the River.

I conceive that one great object which the trustees will keep in view for the improvement of the navigation is, to bring up the tidal waters as early as possible, and in a large body, to the harbour at Glasgow. At present flood tide is more than three hours later in reaching Glasgow than Port-Glasgow, so that the tide has risen 4 feet at Port-Glasgow before it begins to rise at all at the Broomielaw. This is a great loss of time and tide to all vessels going up the river, because, although they may have the flood with them at Port-Glasgow and at Garmoyle, they would get before it and encounter the ebb before getting to Bowling, or a little beyond it; so that in proceeding they would both encounter the ebb tide and want of water. To vessels going down the river, on the other hand, it is of equal importance, especially if of considerable size, that the water should arrive to float them at the Broomielaw, so as to clear out and begin to descend before high water, especially at neap tides, with easterly winds, and little fresh in the channel. At present there are only about 4½ hours of flood, and nearly 8 of ebb at the Broomielaw, so that heavily-laden vessels find the water gone away from the Port-Glasgow banks before getting across them.

These evils are, however, rapidly decreasing, and may ultimately, by judicious means, be entirely removed. I do not hesitate to express my decided conviction, in the first place, that flood tide may be made to commence at the Broomielaw an hour and a half earlier than at present, and to ascend the river so rapidly that a vessel leaving Port-Glasgow early in the flood, shall find the flood before her all the way up. Secondly, that the tide, instead of rising, as at present, much less above low-water mark at the Broomielaw than at Port-Glasgow, may be made to rise not only considerably more than it does at present, but even more than it does at Port-Glasgow or Greenock. And, indeed, it appears from observation, that the top of high water at the Broomielaw is at present nearly 1 foot higher than the top of high water at Port-Glasgow; so that the absolute height of the tide does at present actually increase as it ascends the river, and may be made to do so to an extent considerably greater. In the third place, a much greater body of water may be brought up the river than at present, by beginning earlier, flowing longer, and rising higher. In the fourth place, the time of high water at Glasgow may still be rendered 23 or 25 minutes earlier than at present. In the next place, the water sent up into the river may be retarded in its egress, so as never to fall so low at low water as it now does. And, lastly, that the navigation of the river may be improved, so that vessels shall move in it with less resistance than at present, and shall sail both more rapidly and with a less expenditure of fuel and power.

Now, all these things are to be accomplished only by persevering in a systematic method of

No. 340.
Russell, on the Tidal Wave of the Clyde, the state of the Channel, and the Improvement of the Navigation, with Table of Tides.

improving the channel of the river. Already, by previous improvements under the management of your excellent and judicious engineer, much good has been done; the flow of the tide up the river is in a gradual process of acceleration, so that whereas it was at the beginning of the present century 2 hours in ascending from Port-Glasgow to Glasgow, the same distance is now done in 1 hour 23 minutes; so that the tide wave of high water, which formerly moved up the river at the rate of 9 miles an hour, now passes over the same ground at the rate of about 14 miles an hour. Now I have the means of predicting, with certainty, that if the depth of the river shall be increased so as to have at high water more than 20 feet, as I trust it will be, then will the tide be found to move at an increased velocity, so that high water will be obtained in the harbour of Glasgow within an hour after it has come to Port-Glasgow. Now this is to be obtained by an increase of depth, and by that alone, any increase of width being of no consequence, except insofar as the stability of the banks, and the facility of vessels passing each other, may require it.

In reference to this subject, the following observations may be of some importance:—

The wave of high water comes up from Port-Glasgow to Bowling, 8 miles, in 24 minutes; Bowling to Clyde Bank, 5 miles, in 37 minutes; Clyde Bank to Broomielaw, 5 miles, in 22 minutes.

These results are remarkable, as showing the effect of the nature of the channel on the propagation of the tide wave. In the deep water from Port-Glasgow to Bowling, the tide wave moves at the rate of 20 miles an hour. Between Bowling and Clyde Bank it will appear, by inspecting the accurate map of Mr. Kyle, and the excellent sections by Mr. Logan, that the channel becomes broad, the depth at high water variable, and the medium or mean depth, reckoned all the way across, comparatively small; now, here the tide wave of high water takes 37 minutes to travel over these 5 miles, being at little more than 8 miles an hour; but, during the last portion of its course, from Clyde Bank to Glasgow, where the river is perfectly enclosed, and the depth of the channel tolerably uniform, and its mean depth much greater than in the former case, the tide wave travels more rapidly, or at the rate of nearly 15 miles an hour.

It is therefore between Clyde Bank and Bowling that the great loss at present takes place. If this be remedied, and the proper depth and form of channel be obtained, we shall have the tide accelerated in the manner above noticed. These observations point out quite decidedly where the loss exists, and how it is to be remedied.

Next, I shall consider the course of the river. My observations on the tides induce me to differ considerably from some authorities upon this point. I do not think that a perfectly straight course would prove advantageous to the navigation of the river. I prefer gentle curves, but by no means sharp turns in the channel. Such gentle bends as the river will have when it is modified according to the Parliamentary plans of your engineer, will be, in my opinion, much preferable to a straight course, as well as much cheaper. I have good reasons to suppose that a straight course would have the effect of emptying the channel of the tidal waters so rapidly and entirely, that the depth would diminish much sooner after high water than at present, and be much lessened at low water, without any corresponding advantage at high water. By giving the curves a certain form, and having them considerably deeper on the outer than the inner side of the channel, these curves may be prevented from impeding the tide as it ascends the river, and at the same time they will have the effect of detaining in the river the water which has ascended during flood-tide. This advantage would be lost if the river were made perfectly straight.

In regard to the width of the channel, I may add, that I highly approve of gradually increasing that width all the way down. I should approve of this being done below Dumbarton, to a much greater extent than has yet been accomplished; and I am led to expect, from all my observations, that some feet of water will be gained all the way up the channel if this be done on the proper principle.

In regard to the form of the banks of the river, as seen in the transverse sections, I have a good many circumstances to notice, but this paper is already too long. I may state shortly, however, that I am led by all my observations to the conclusion that long slopes and gentle declivities on the banks of a river, although generally approved of, are not good, and they certainly impede very much the ascent of the tide. Still, however, a certain slope is required for the support of the banks, and the inclination must depend, to a considerable extent, on the materials used. It is enough therefore to state, at present, as a general principle, that the nearer the banks are to the perpendicular the better, insofar as the progress of the tide up the river is concerned.

Lastly, regarding the kind of channel best suited to the motion of steam-vessels, and most calculated to prevent the banks from injury, I am happy to say, that the numerous observations and experiments I have made upon this subject lead me to the conclusion, that the same form which is suited to bring up the tide in the best manner, is also best for the general interests of the navigation of vessels, and that depth is the great requisite. It appears that if the depth of the channel at low water were not more than 7 or 8 feet, no power of steam that could be applied would produce a speed of 10 miles an hour, and that the same power and fuel which in shallow water only produce a speed of 8 miles an hour, would, in deep water, produce a speed of 12. To all vessels, therefore, even to those of small dimensions, which draw least water, the shallowness of the river for several hours about low water, is a great impediment to speed, and produces a great waste of power, and expenditure of fuel, which will be saved by making the channel as deep as possible. There is also a particular form of bank, and construction of the slopes of the river, which will be less affected by the washing of the steam-boat surge than any other; but this would require to be explained by drawings, and would extend this Report to a greater length than proper. On the subject of the resistance of canals and shallow rivers to navigation, I enclose, for the acceptance of the trustees, a paper of mine, printed by the Royal Society, and for which they have just voted me a valuable piece of plate, as the most important communication made to them during the last two years. The trustees will be able to see in that Report, that I began to study the navigation of the River Clyde some years ago.

I may add, that the injury done to the banks of the river, arises principally from the shallowness of the river at low water. Any one may notice that the commotion produced by a steam-boat is greater at low water than at high water, and greater at a shallow part of the river than where it is deep.

It appears, therefore, on the whole, that the improvements on the River Clyde have already materially affected the propagation of the tide, so that high water is now brought up to Glasgow 37 minutes earlier than it used to be, and rises nearly 1 foot above the level of high water at Port-Glasgow. It appears, also, that high water may still be brought to Glasgow 23 minutes earlier than at present, and that flood-tide may be made to commence more than an hour and a half earlier; that the duration of flood-tide may be lengthened, and the duration of the ebb proportionally shortened;

APPENDIX C.
GLASGOW.
No. 340.
Russell, on the Tidal Wave of the Clyde, the state of the Channel, and the Improvement of the Navigation, with Table of Tides.

that the rise of the water at Glasgow may still be considerably increased; that a larger body of water may be brought up the river earlier than at present, and a greater quantity of it retained in the river, so as to facilitate the navigation at low water; and that the river may be expected to become better suited for the speed and economical use of power in vessels of all classes. I have already said, that these observations will enable us very much to improve the tide-tables now in use. I may also add, that it appears to be of great importance that the trustees should continue these observations, by ordering daily tide observations, of at least high and low water, to be accurately and regularly made, both at the Broomielaw and at Port-Glasgow, as it is by that means alone they can learn, from time to time, what effects their daily operations are producing upon the tides of the river. At London, Leith, Bristol, Portsmouth, Plymouth, and Liverpool, this is done regularly, and with the greatest advantage to the navigation of these ports. It is to be hoped that Glasgow will not long remain without similar advantages.

In conclusion, I have much pleasure in acknowledging the great benefit I have derived from your able engineer. I have found his views of the nature of water, and of the means of opposing its action, or modifying its effects, very thorough and correct. I have also to add, that, under the enlightened and disinterested administration of the present body of trustees, the affairs of the river will, I have no doubt, continue to prosper, and that the river Clyde, and the harbour of Glasgow will long remain an imposing and permanent monument of the enterprise, judgment, science, and commercial success of the citizens of Glasgow.

I have, &c.,
JOHN SCOTT RUSSELL.

SIR, *Glasgow, April* 14, 1838.

I HAVE just received the proof-sheet of Tidal Observations, as also the manuscript table and diagram you returned to Mr. Turner. One of the Clyde trustees had obtained the papers, and did not hand them to me till yesterday. This will account for the delay. I observe that in the table there are a number of blanks; and that you have omitted to put down the time of high water and low water A.M. or P.M. at the several stations each day. Please send me this, and I will add it in printing the table. You will at once see, that without this addition the table will be incomplete. Where high W.M. is put down thus—9 ft. 8·8 in., I imagine it means 9 feet 8 inches and 8-tenths or twelfths of an inch; please say which. And where you say, "to find the height on the gauge, substract 3·44 feet," I suppose 3 feet 4 inches and 4-tenths or twelfths is meant.

I am, &c.,
DAVID BELL.

To John Scott Russell, Esq., M.A., F.R.S.E., &c.

SIR, 21, *Coate's Crescent, Edinburgh, April* 16, 1838.

IN reply to yours of the 14th, I have to say, in reference to the Table of Observations:—

1. That the blanks are left where the tides were not observed; but all that were observed, are put down in the table.

2. Where high W. M. is put down thus—9 ft. 8·8 in., it means 9 feet 8 inches and 8-tenths of an inch.

3. Where you substract 3·44 feet, it means 3 feet 4-tenths of a foot and 4 hundredths, according to the usual decimal notation which surveyors always use in speaking of levels.

4. The table is not intended to contain the time of the tides at the different stations. You will find in the body of my Report, a table given of the difference of time at all the stations; but as the mean solar time of the individual observations was not what I thought of importance, I have only obtained their differences. All the observations having been made with different chronometers, going at different rates, and in different latitudes and longitudes, it would require a great deal of laborious and tedious calculation to bring out the mean solar time on the meridian of Glasgow of each observation. If, however, the trustees would wish to go to the expense of such a set of calculations, it may be done for them in about a week or ten days after the order is given.

I have, &c.,
JOHN SCOTT RUSSELL.

To David Bell, Esq., Glasgow.

TABLE of TIDES observed on the RIVER and FRITH of CLYDE, during April and May, 1837, under the Superintendence of JOHN SCOTT RUSSELL, Esq., M.A., F.R.S., Edinburgh.—By the Authority of the Honourable Board of Trustees of the River Clyde.

All the Observations were made upon a level plane, carefully taken by Mr Kyle, from a point 20 feet below the summit of the granite coping of the New Quay on the south side of the Harbour of Glasgow.

		STRENGTH AND DIRECTION OF WIND.																				
		April 20. Gentle, S.W.	April 21. Gentle, S.E. & E.	April 22. Fresh, E. & S.E.	April 24. Gentle, E. & W.	April 25. Moderate, S. & S.E.	April 26. Strong, W. & S.W.	April 27. Gentle, W. & S.W.	April 28. Gentle, W. & S.W.	April 29. Fresh, E. & S.E.	May 1. Breeze, W. & S.W.	May 2. Strong, W.	May 3. Gentle, E.	May 4. Strong, N.W.	May 5. Moderate, E. & W.	May 6. Gentle, E. & W.	May 8. Moderate, E.	May 9. Smart, N.E.	May 10. Gentle, S.	May 11. Gentle, E. by S.	May 12. Gentle, S.	May 13. Gentle, S.
		Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.
Station I.—Broomielaw.																						
To find the Height on the Gauge subtract 3·44 ft.	High W. M.	[illegible]	11 10·2	11 4·2	11 0·2	12 1·2	11 11·2	10 11·9	10 2·3	9 9·2	13 [illegible]	12 2·7	11 10·7	12 5·5	11 9·7	11 4·5	10 11·2	10 4·0	10 2·2	9 0·5	9 0·0	[illegible]
	Low W. M.	..	..	..	4 0·3	4 0·3	4 7·0	4 3·7	3 10·5	4 9·8	..	5 5·7	4 2·3	4 10·0	4 1·7	3 7·0	3 10·2	5 8·0	5 6·6	3 5·8	4 10·2	[illegible]
	Rise & Fall	..	..	..	7 0·0	7 0·0	7 4·2	6 7·5	6 3·8	5 0·0	..	6 9·0	7 8·4	7 7·5	7 8·0	7 9·5	7 1·0	6 7·4	5 5·4	6 0·7	5 7·8	[illegible]
Station II.—Cranford's Quay.																						
To find the Height on the Gauge, subtract 3·01 ft.	High W. M.	11 0	12 9·9	11 3·2	11 0·0	12 0·2	11 10·7	10 11·2	10 1·7	9 10·2	12 10·7	12 1·7	11 9·2	12 6·2	11 6·5	11 3·2	..	..	..	..	..	..
	Low W. M.	3 0	3 9·2	3 4·7	3 11·2	4 2·2	4 4·7	4 1·0	3 8·2	..	6 4·7	5 4·5	4 2·2	4 2·2	4 0·2	3 7·7	..	..	..	..	..	..
	Rise & Fall	7 0	7 11·3	7 0·8	7 0·6	7 10·0	7 6·0	6 10·2	6 4·6	..	6 6·0	6 9·2	7 7·6	7 8·1	7 6·3	7 5·5	..	..	..	..	..	..
Station III.—Clyde Bank.																						
To find the Height on the Gauge, subtract 3·01 ft.	High W. M.	..	11 0·1	11 1·7	11 6·1	11 9·9	11 7·6	10 8·1	9 11·6	9 9·1	12 7·1	11 11·3	11 2·3	12 9·1	11 5·8	11 0·9	..	..	..	..	..	..
	Low W. M.	..	3 7·0	3 9·1	3 10·1	4 1·1	4 3·1	3 11·1	3 6·3	3 7·1	6 1·2	5 0·1	3 11·1	4 3·1	3 11·5	3 6·1	..	..	..	..	..	..
	Rise & Fall	..	7 10·0	7 4·0	7 7·0	7 8·0	7 4·5	6 9·0	6 5·3	6 2·0	6 5·9	6 11·2	7 3·2	7 9·0	7 5·7	7 6·8	..	..	..	..	..	..
Station IV.—Rashilee Pier.																						
To find the Height on the Gauge, subtract 3·3 ft.	High W. M.	..	..	..	..	..	11 0·0	10 7·2	9 10·6	9 10·0	..	..	..	..	..	..	..	..	..	..	..	..
	Low W. M.	..	..	..	..	..	4 0·2	3 8·7	3 4·9	3 11·7	..	..	..	..	..	..	..	..	..	..	..	..
	Rise & Fall	..	..	..	..	..	7 5·8	6 0·5	6 6·3	5 11·3	..	..	..	..	..	..	..	..	..	..	..	..
Station V.—Bowling Bay.																						
To find the Height on the Gauge, subtract 2·0 ft.	High W. M.	..	..	..	11 0·3	11 10·3	11 4·8	10 6·3	9 8·3	9 8·3	12 4·5	11 3·3	11 6·6	11 10·3	11 5·0	11 2·3	..	..	..	..	..	..
	Low W. M.	..	..	..	..	2 11·3	3 4·3	3 0·3	2 8·3	2 2·3	4 3·3	4 1·8	3 1·8	3 2·3	3 6·3	2 9·8	..	..	..	..	..	..
	Rise & Fall	..	..	..	..	9 11·0	8 0·5	7 6·2	6 11·7	7 6·0	8 1·2	7 6·5	8 4·8	8 8·0	8 5·3	8 4·5	..	..	..	..	..	..
Station VI.—Garmoyle.																						
To find the Height on the Gauge, add 7 inches.	High W. M.	..	..	..	11 3·7	11 6·6	11 1·0	10 2·0	9 6·5	9 9·7	11 9·0	11 5·2	11 3·2	11 6·0	11 2·0	10 11·	..	..	..	..	..	..
	Low W. M.	..	..	..	..	1 0·0	1 0·0	1 0·2	1 9·2	1 7·0	1 10·0	2 7·0	1 7·0	1 3·0	1 1·5	0 10·	..	..	..	..	..	..
	Rise & Fall	..	..	..	..	10 6·5	10 4·0	9 1·8	7 9·3	8 1·7	9 10·6	8 8·2	9 9·2	10 2·0	10 0·8	10 1·	..	..	..	..	..	..
Station VII.—Port Glasgow.																						
To find the Height on the Gauge, subtract 1·03 ft.	High W. M.	..	11 2·9	10 9·4	11 9·9	11 0·3	10 10·0	10 1·1	9 4·1	9 5·9	11 3·4	11 1·3	11 1·3	11 3·1	10 11·0	10 0·9	..	..	..	..	..	..
	Low W. M.	..	..	..	[illegible]	0 10·2	..	2 11·8	1 10·1	1 0·6	1 6·3	2 4·3	1 7·3	0 10·0	0 10·6	0 5·0	..	..	..	..	..	..
	Rise & Fall	..	..	..	[illegible]	10 8·7	..	8 1·3	7 6·0	7 6·0	9 9·1	8 9·0	9 6·0	10 4·2	10 1·0	10 3·8	..	..	..	..	..	..
Station VIII.—Cloch Light.																						
To find the Height on the Gauge, subtract 0 in.	High W. M.	..	..	..	10 0·8	11 3·0	10 7·0	9 0·5	9 1·0	9 4·0	..	10 0·2	10 10·0	10 10·5	10 7·7	10 0·6	9 11·7	9 4·2	9 1·2	9 6·0	8 5·7	9 0·0
	Low W. M.	..	..	..	..	..	1 0·0	1 10·	1 0·7	1 10·5	1 3·3	2 5·5	1 6·5	1 0·5	0 8·2	0 5·0	2 1·2	1 2·5	1 8·7	2 2·0	3 2·2	2 4·0
	Rise & Fall	..	..	..	..	..	9 10·0	7 11·0	7 3·8	7 6·0	..	8 5·7	9 3·5	9 10·5	9 6·5	10 1·0	8 10·5	8 1·7	7 4·5	6 6·0	5 3·8	6 8·0
Station IX.—Cumbray Light.																						
To find the Height on the Gauge, subtract 0 in.	High W. M.	..	..	..	..	..	..	..	..	..	..	..	10 0·0	10 1·0	9 0·0	9 0·5	9 2·5	9 7·2	9 4·5	7 11·7	7 0·7	..
	Low W. M.	..	..	..	..	..	..	..	..	..	..	..	1 4·7	0 11·0	0 0·0	0 0·0	0 11·2	1 0·7	1 0·5	1 10·7	2 10·2	..
	Rise & Fall	..	..	..	..	..	..	..	..	..	..	..	8 7·0	9 2·0	9 1·0	9 2·2	8 3·3	7 6·5	5 10·0	6 1·0	4 11·5	..

APPENDIX C.

GLASGOW.

No. 341. Bald, on a part of the River Clyde, between Jamaica-street Bridge and the Glasgow Water-Works.

No. 341.

General Report on a Part of the River Clyde, between Jamaica-street Bridge and the Glasgow Water Works. By WILLIAM BALD, Esq., F.R.S.E., M.R.I.A., &c., C.E.

MY LORD AND GENTLEMEN, *Glasgow, July* 31, 1839.

IN obedience to the orders communicated to me by Alexander Johnston, Esq., of Shieldhall, and which are contained in a resolution of the Clyde trustees, I have examined the River Clyde, from the New Bridge of Glasgow to the Upper Water Works of the city of Glasgow, situated on the Clyde. I have read over the evidence of the late Thomas Telford, Esq., which had been sent to me, and also the evidence of James Jardine, Esq., regarding the Glasgow Water Works, erected on the banks of the river.

In reporting on a subject connected with so many matters, which have a reference not only to the improvement of the River Clyde and the Port of Glasgow, but also to that of the manufacturing interests of this city, I should have been better able to have performed this service if I could have procured accurate sections, plans, and levels of the surface, bottom, and banks of that part of the River Clyde, and also of the various works connected with it between the harbour of the Broomielaw and the highest reach of the Clyde to which the tidal flow extends.

In making the examination, Mr. Mackain, engineer to the Glasgow Water Works, accompanied me, gave me every information in his power, and was so obliging as to lend me a longitudinal section of a considerable portion of the Clyde. Among the maps belonging to the Clyde trustees, I found a plan of the river, extending from the Broomielaw harbour to the village of Carmyle; but this map does not specify any of the levels, soundings, borings, or the nature of the soil in the bed of the river; nor does it describe, by shading or section, the embankments and sloping grounds along its borders, or give the velocity of the river and tidal currents up and down; an element of great importance to be known. The plan or map alluded to is a mere outline plan, destitute of all those exact elements so valuable to an engineer in drawing up a Report.

I shall, however, offer a few leading observations regarding the great and numerous benefits which would result to the maritime and commercial prosperity of the city of Glasgow and its neighbourhood, by opening the upper navigation of the Clyde; and, in doing so, I beg it to be understood, that I shall express my views frankly and freely, without reference to any authority, however high, my chief endeavour being not to recommend any measures which shall not be found, upon examination, to be sufficient to sustain themselves if impartially investigated.

I maintain, that the first great step to improve and extend the trade of Glasgow, is to increase the width and depth of the River Clyde, and to render it safe in every part of its navigation; secondly, to give sufficient room and full protection to all ships frequenting the harbour or port of the city. But, to attain the first of these important objects, it is necessary to observe, that to preserve depth in river channels by artificial means is attended with a constant and a considerable expense; but if natural means can be called into action to secure depth, and also width, or even partly to assist in doing so, it would be extremely desirable, and is the first thing which should occupy the attention of the engineer in the improvement of a tidal river channel. If increased width be contemplated for any river beyond the limits which nature has assigned to it for the discharge of its land-flood waters, it will decrease in depth what has been given to it in depth; and, on the other hand, if the natural breadth of a river be narrowed, it will acquire in depth what has been taken from it in width; taking into account the nature of the soil at the bottom and on the sides of the river, and the velocity of the water current.

Reflecting on these fundamental principles, and looking at the River Clyde, and the great necessity there exists of giving it increased breadth for the purposes of navigation, the first consideration should be, to preserve the depth where increased width is proposed to be given to it, by the immediate removal of every kind of obstacle which in any manner interferes with the free tidal flow of the sea-water upwards, by deepening and widening the channel of entrance, clearing away all banks, shoals, and obstructions, so that the sea-tide flood may ascend freely upwards, to the greatest extent that it can possibly reach.

It is manifest, that any plan that shall increase the volume of water into the upper reaches of the Clyde above the city of Glasgow will be attended with the most beneficial results. The tide-water in the harbour will be increased; the time of high water will be more early, thereby enabling ships, outward and inward bound, to reach the port sooner and depart from it earlier. The velocity of the tide of flood and ebb would be increased, not only through the harbour, but also through the whole navigable channel of the Clyde; and even for some distance this scouring power would be felt above Hutcheson's Bridge, by which the whole impurities of the sewerage of the city would be washed away downwards by the ebbing tidal current, and which would render Glasgow more healthy, and the water in the harbour more pure.

By the removal of the weir at the New Bridge, the Clyde could be deepened upwards in such a manner as to allow a volume of water each tide to ascend the Clyde towards Dalmarnock Ford, of about 13,200,000 cubic feet,* equal to 367,242 tons.

$$\left(6{,}232\times 13{,}200{,}000 = 82{,}262{,}400 \text{ gallons, or } \frac{13{,}200{,}000\times 62\cdot5}{2{,}240} = 368{,}303 \text{ tons}\right).$$

The removal of the weir would give a volume of water each tide, into the upper reaches of the Clyde, to the end of the tidal flow above the Glasgow Works, of 20,400,000 cubic feet of water,† equal to 567,557 tons.

$$\left(6{,}232\times 20{,}400{,}000 = 127{,}132{,}800 \text{ gallons, or } \frac{20{,}400{,}000\times 62\cdot5}{2{,}240} = 569{,}196 \text{ tons}\right).$$

$$\begin{array}{rl}
{}^{*}\ 2{,}500\times6\times400 = 6{,}000{,}000 & \\
6{,}000\times6\times200 = 7{,}200{,}000 & \\
\hline & 13{,}200{,}000 \\
{}^{\dagger}\ 12{,}000\times3\times200 = 7{,}200{,}000 & \\
\hline & 20{,}400{,}000 \\
 & 10\cdot0288 \text{ lbs.}
\end{array}$$

No. 341.
Bald, on a part of the River Clyde between Jamaica street Bridge and the Glasgow Water-Works.

This is nearly equal to a river line of four miles long, four feet deep, and 242 feet wide. This immense volume of water, ascending and descending each tide, would eminently tend to carry away all impurities which are discharged into the Clyde at Glasgow; indeed, the effects of this scouring power would be felt towards the lower extremities of the River Clyde, as far as the banks opposite Port-Glasgow and Greenock.

The removal of the weir would at once open an extent of river between the New Bridge and Hutcheson's Bridge, of nearly 23 acres, equal in extent to the whole of the lower harbour; and a deepening of three or four feet would enable all the smaller craft in the lower harbour to ascend into the very centre of the city, which would be a great relief to the lower port, where the large ships lie. But this upper harbour of 23 acres is quite capable of being so improved that ships of the largest class might lie in it, and Glasgow would then indeed have the aspect of a great maritime port. To those who have visited some of the continental harbours and cities, such, for example, as Amsterdam and Rotterdam, nothing can appear more natural and simple than to convert the whole of the Clyde, between the New Bridge and Hutcheson's Bridge, into a large floating harbour. Its position, in the very middle of the city, would confer many advantages on the merchant and trader.

In the first instance, the weir might be lowered about three feet; the bed of the river between the new and the old bridge deepened three feet, and between that bridge and the city wharf, deepened only two feet. I am of opinion that this extent of deepening will not endanger the old bridge at Stockwell-street if proper precaution be taken; and this first step would afford immediate relief to the lower harbour, by affording ample room to all the smaller craft to berth themselves between the bridges.

I am quite aware that none of the Acts of Parliament permit the river trustees to deepen any part of the Clyde above Stockwell-street Bridge; yet, notwithstanding, if the river were deepened even so far up as that bridge, it would be a most important advantage. The space between the new bridge and the old is about 1500 feet long by nearly 400 feet wide, being an area of more than 13 acres; it would therefore afford immense accommodation to the smaller vessels frequenting the port of Glasgow.

It is really to be regretted that so magnificent a harbour improvement should be sealed up, and prevented from being carried into execution on account of the existence of the weir at the new bridge. I am aware that it has been, and continues to be, a source of very deep regret to that active and commercial intelligence which so pre-eminently distinguishes the inhabitants of this great city, to have seen, for so long a period, a space so large lying wholly unoccupied, and which might be so easily and so cheaply converted into a most useful harbour; while, on the other hand, the lower port is so crowded with vessels that hardly a berth can be procured, nor even the necessary repairs made to parts of the quay-walls, without seriously inconveniencing the shipping; and all this has arisen about the lowering of the weir, which the Glasgow Water Company object to, as being injurious to their interest. On this important point I shall now proceed to offer a few observations.

The principal objection offered to the removal of the weir at the Glasgow new bridge has been made by the Glasgow Water Company. They state that it would lower the level of their present supply. Now, looking at the Glasgow Water Works, and the numerous public interests connected with them, both industrial and manufacturing, looking at the immense steam-power employed in the Water Works, amounting to no less, when completed, than 682 horse power; and again, at the vast capital which has been invested in those works, it really, on public grounds, becomes a question of the greatest importance in deepening the River Clyde, and improving and enlarging the port of the city of Glasgow, to preserve these Water Works from sustaining any injury, either in lowering the existing level of the water in the Clyde or deteriorating the quality of the water which affords the supply. On this most important subject we fortunately have on record the evidence of the late Mr. Thomas Telford, and we have also the very clear and very able evidence of Mr. James Jardine, engineer to the Edinburgh Water Works; both of these gentlemen mention distinctly, that if the bottom of the ford at Dalmarnock Bridge be secured, so that its present level remain undisturbed, the weir may then be taken away at the Glasgow Bridge, and the Clyde deepened between Dalmarnock Ford and that bridge for about six feet, without, in their opinion, doing any injury to the Glasgow Water Works. But be it understood that the work which they recommended was not to rise above the level of the present bed of the Clyde at Dalmarnock Ford; for Mr. Telford says in his evidence, that when the bed of the river would be secured, "a stranger would be unconscious of any such operation having been performed there," because no weir would be seen traversing the Clyde. Numerous interests would, I fear, offer many serious objections to the erection of a weir rising even a few inches above the bed of the Clyde at Dalmarnock Ford.*

Attentively reflecting on the evidence of Mr. Telford and Mr. Jardine, regarding the Glasgow Water Works, and considering that the Ford of Dalmarnock is at present nearly 18 inches above the level of the Clyde, where the present supply is taken for the Cranstonhill Water Works, I think it possible to obtain a supply of water from the level of the river at Dalmarnock, without raising its level by the construction of any weirs rising above the present bed of the Clyde at that point, by simply securing the existing level of the river waters at the ford; for I frankly avow, that I am decidedly opposed to the erection of any weirs across the bed of the Clyde. It would perhaps even be much better to carry a sufficient quantity of water from a still higher level of the Clyde, to supply the Water Works, than in any manner to interfere with the river channel, by the erection of engineering works which would obstruct the free passage of the land and tide waters, and prevent the navigation from being improved hereafter in the higher reaches; and also to enlarge and extend those natural tidal flows or scouring powers which would not only act so beneficially in cleansing all deposition caused

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* "*An Act for the Preservation of Public Harbours of the United Kingdom*:—

"Whereas, the preservation of the public harbours of the United Kingdom is of great importance to the commerce and security thereof; be it therefore enacted by the King's Most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, That from and after the passing of this Act, it shall not be lawful for any person or persons to make, construct, or erect any pier, quay, wharf, jetty, breast, or embankment, in or adjoining to any public harbour in the United Kingdom, or any river immediately communicating therewith, so far as the tide flows up the same, without giving, at least, one month's previous notice of his, her, or their intention so to do, to the Secretary of the Admiralty, who is to lay the same before the Lord High Admiral or Lords Commissioners of the Admiralty for the time being; the receipt of which notice the said Secretary is hereby required duly to acknowledge, upon pain that every person or persons offending shall forfeit and pay the sum of Two hundred pounds, to be recovered by action of debt, bill, plaint, or information, in which no essoign, protection, privilege, wager of law, or more than one imparlance shall be granted or allowed."—43 Geo. III. c. 153.

APPENDIX C.

GLASGOW.

No. 341.
Bald, on a part of the River Clyde between Jamaica-street Bridge and the Glasgow Water-Works.

by the city sewers, but would also be of great benefit to the harbour in keeping it clear, as well as the whole channel bed of the river downwards. I AM UNABLE TO FIND LANGUAGE TO EXPRESS ALL MY THOUGHTS ON THE GREAT VALUE WHICH I ATTACH TO THIS UPPER SCOURING POWER, *and on the necessity which exists, that no part of the bed of the river shall ever be encumbered either with weirs, dykes, or locks, where it may be possible for the tidal rise to reach, or to which it at present extends.**

Looking at the triumphant success with which the open tidal estuaries of rivers have been navigated since the application of steam-power to maritime purposes, looking at the improvements which are being made in so many rivers, not only in Great Britain and Ireland, but also the New and the Old Continents, to facilitate and extend the progress of this power into the most remote corners where the tide flows, and the extension of this power, which so peculiarly characterises and adorns the Clyde, the cradle of steam navigation; its further extension into the highest tidal reaches of the Clyde at once claims and demands the deepest attention of those intrusted with the direction and improvement of the river and the port of this great city. Reflecting on the events of the last 25 years, in the improvement of the Lower Clyde, who can tell to what an extent the improvement of the upper reaches of the river may not be carried?

In offering these few and limited observations on a small part of the Upper Clyde, I regret exceedingly that it has not been in my power at present to bring under review the improvement of the lower water-basin of the Clyde, from the Jamaica-street Bridge to Port-Glasgow; the nature of the wide expanse of the tidal estuary, as well as the narrow parts; the cause of the formation of the sandbanks and shoals opposite Port-Glasgow and Greenock; the basin of the Leven, the Cart, and the Kelvin, and their influence on the ship channel. And as regards the Upper Clyde, I more particularly regret not being able to give the soundings, levels, nature of the bottom of the river, and the form of its bed according to the various strata; the limit of the high floods, and those of low water, during summer and winter; the mode of securing the sides of the river when deepened; the area of the dry basin of the Clyde; the quantity of water falling within it in a year; the average daily quantity passing through it at the city of Glasgow; the quantity of alluvium held in suspension by its waters; the limit to which the sea-water reaches, and ceases to be sensible to the taste; the mean hydraulic depth at numerous places. These are subjects highly instructive to the engineer in devising plans for the improvement of estuaries, rivers, and harbours situated within them. I hope I shall be able, at no distant period, to submit to the trustees a detailed report upon the dry and water basins of the Clyde. Those basins will be found the most interesting in Scotland, whether as regards their physical structure, the immense and almost inexhaustible mineral wealth which they contain, or their capability of improvement in the tidal navigation, combined with the probable connecting ramifications of railways. All those matters are intimately connected and blended with the rising commercial prosperity of the city of Glasgow, its port, and its river.

I am obliged to bring under your consideration the great and pressing necessity which exists of affording immediate accommodation to a large class of steamers, built or now being built, and which may require to be furnished with engines. My feeling on this subject is so great that I cannot refrain from hoping that this branch of mechanical industry will receive at the hands of the river trustees all that protection to which it is so justly entitled, forming, as it does, a branch of national industry, not only highly creditable to Scotland and to the genius of her people, but employing thousands of her mechanics, diffusing wealth among numerous classes, and calling into full activity that peculiar mechanical and inventive power which has extended the fame of this land and its inhabitants through the most remote and distant regions of the earth.

This accommodation for steamers of the largest class ought, as soon as possible, to be afforded, although it should only consist of a simple excavation on the side of the earthen bank of the Clyde, bordered with a small cheap wharf, constructed of home-grown timber; and this might be done below the present quay-walls, without interfering with the present shipping accommodation, situated at the lower reaches at the entrance to the harbour.

I have, &c.,
WILLIAM BALD.

*To the Trustees for Improving the River Clyde and
the Port of the City of Glasgow.*

No. 342.

Comparative Levels of the Tides in the Clyde and Widths of the River.

Table No. 1.—Level of Tides.

Spring Tide 20th of March 1840, taken simultaneously at various parts of the River with the Flowing and Ebbing Tides, from a Section by Mr. Kyle.

Flowing Tide.

Place.	Distance from Glasgow Bridge in miles and furlongs.	Low Water.		High Water.		Rise.	Time.	6 0 A.M.	9 0 A.M.	10 0 A.M.	11 0 A.M.	12 0 Noon.	1 0 P.M.	2 0 P.M.
		A.M.	ft. in.	P.M.	ft. in.	ft. in.	h. m.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
Port Glasgow .	18 5	7 10	19 9½	1 25	9 6⅓	10 2¾	6 15	18 4	16 3	15 0	13 2¼	11 3½	9 8¼	9 11
Bowling . .	10 3½	8 38	17 8	2 5	9 2	6 6	5 27	0 0	17 2	15 9	14 8	13 1	10 9¼	9 1
Clyde Bank .	5 3⅔	9 30	16 11	2 50	9 2	7 9	5 20	0 0	0 0	16 4	15 3	13 10½	12 2	9 11
Glasgow . .	0 0	10 0	17 0	3 10	8 10½	6 1½	5 10	0 0	0 0	17 0	15 4	13 11½	12 3	10 1

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* The writers on the law of waters and on the rights of the sea, are seriously opposed to the existence of any such work as the weir across the bed of the Clyde at the Glasgow Bridge.

Ebbing Tide.—Same Day.

Place.	Distance from Glasgow Bridge in miles and furlongs.	High Water		Low Water.		Fall.	Time.	3 10 P. M	4 10 P. M.	5 10 P. M.	6 10 P. M.	7 10 P. M.	6 10 P. M.	9 10 P. M.
		P. M	ft. in.	P. M.	ft. in.	ft. in.	h. m.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
Port Glasgow .	16 5	1 25	9 6½	7 20	19 11½	10 4¾	5 55	12 1	14 8	16 8	18 8	19 9½		
Bowling . .	10 3½	2 5	9 2	8 53	17 8½	6 6½	6 48	10 7	11 11	13 2	14 4½	15 10	17 1	
Clyde Bank .	5 3¾	2 50	9 2	9 48	17 0	7 10	6 58	9 5	10 8	12 0	13 3½	14 5	15 6½	16 8
Glasgow . .	0 0	3 10	6 10½	10 15	17 0	6 1½	7 5	8 10½	10 3¾	11 9	13 0	14 1½	15 3	16 3

Neap Tide of 27th March 1840, Wind light, no Fresh.

——	High Water.	Low Water.	Fall.	
	ft. in.	ft. in.	ft. in.	
Port Glasgow	12 7	17 8	5 1	High water at Glasgow 6 inches higher than at Port Glasgow.
Bowling	12 3	17 6	5 3	Low water at Glasgow 3 inches higher than at Port Glasgow.
Clyde Bank	12 1	17 4	5 3	
Glasgow	12 1	17 5	5 4	

High Water of Spring Tide of 24th December 1839, with Fresh, Wind west.

	ft. in.		
Port Glasgow	5 7	under Datum.	*Note.*—Fall on surface of River from Glasgow to Port Glasgow, 1 foot 9 inches.
Bowling	5 0	„	
Clyde Bank	4 6	„	
Glasgow	3 10	„	

Notes.—The above levels all measure downwards from *datum* which is defined by the summit of the coping of the south quay wall at a point near Glasgow Bridge.

Acceleration of tidal flow to Glasgow, from 1824 to 1835 = 17 min.} 20 minutes.
„ „ 1835 to 1840 = 3 min.}

In 16 years the time of high water at Glasgow has been nearer to that at Port Glasgow by 20 minutes, the tide being in 1824 2 hours 5 minutes, and in 1840 1 hour 45 minutes later at Glasgow than Port Glasgow.

Table No. 2.—Comparative Widths.

——	Distance from Glasgow Bridge in miles and furlongs.	As proposed by Mr. Rennie.	As at present.	As proposed by Mr. Logan.	As proposed by Mr. Walker.
		1807	1846	1835	1839
		feet.	feet.	feet.	feet.
Glasgow	0 0	135	420	420	420
Stobcross	1 1	145	160	300	405
River Kelvin	2 1	150	170	300	360
Renfrew	5 3½	230	250	400	390
River Cart	6 3½	240	280	430	470
Henderson's Quay at Rashales	6 1½	340	340	480	500
Bowling	10 3½	440	550	610	695
Dunglass Castle	11 1¾	536	410	630	640
Miller Dickies or Keep North Lighthouse . . .	12 6	696	610	085	1,053
Dumbarton Rock	13 5¾	. .	610	1,200	1,320

Table No. 3.—Dredging Operations, &c., from March to October 1846.

In maintaining Harbour	78,110 cubic yards.	Sand and mud.
In deepening, widening, and maintaining river . . .	88,130 „	Clay, boulders, gravel, & sand.
Total lifted and deposited in seven months . .	166,240 „	

Diving-bell lifted 430 tons of stones from the bed of the river, varying from half a ton to five tons weight each.

D. Bremner.

No. 343.
Bald, on proposed new Works for improving the Harbour of Glasgow and the Navigation of the River Clyde.

No. 343.

Report on Proposed New Works for Improving the Harbour of Glasgow and the Navigation of the River Clyde, by WILLIAM BALD, Esq., C.E.

MY LORD AND GENTLEMEN, *February*, 1844.

AGREEABLY to the orders of the Committee of Management, I have drawn out the probable expense which will be incurred in keeping the harbour of Glasgow clear, and also the navigation of the Clyde, with the proper maintenance of the navigable channel, employing the whole of the dredgers and diving-bells during the ensuing year. In drawing up this estimate, I have been guided by the experience of the two past years, as to the expense of working the five steam-dredgers, the steam-tug, and the two diving-bells, including coal, oil, grease, cotton-waste, and cordage. The probable expense of repairs on the five steam-dredgers, tug and punts at Clyde Bank establishment; the depositing of soil dredged out of the river, &c., at White Inch; and the repairing of the river dykes and works about the harbour, will in all amount to a sum of 14,542*l.* 13*s.* 9*d.*

I have tabulated the expense of maintaining the depth of water in the harbour and river for the past year; I have also tabulated the other expense attending the due maintenance, so far as authorized, of the navigation and channel of the Clyde by dredging during the same period. This table is important in showing the expense of maintaining the present depth of water in the harbour and river, and also of further maintaining and improving, to the extent authorized, the channel of the river navigation.

The following are the operations proposed for the still further maintenance of the ship channel of the Clyde, and are given in succession, commencing at the lower part of the river.

The present depth of water in the harbour and river to be first maintained.

Secondly. The channel at the Puddle Deep to be made more direct in its course.

Thirdly. The channel opposite Dumbarton Castle to be deepened and straightened, up to near the head of the Long Dyke.

Fourthly. A part of the navigable channel of the Clyde, at Bowling, has become shoal, and requires to be deepened.

> The ship basin at Bowling would require to be widened on the north side, for a breadth of about 60 feet, so as to give more accommodation to the shipping. This might be done out of the surplus lighthouse dues, applicable to the river as formerly.

Fifthly. A steam-dredge with the two diving-bells, to operate upon the hard ground in the bed of the Clyde, lying between Erskine Ferry and the west end of the Newshot Isle. The bottom of the channel at that part of the river is much encumbered with heavy large stone boulders, which, in my opinion, should be cleared away as much as possible.

Sixthly. The navigable channel of the Clyde, along the north side of the Newshot Isle, to be widened and deepened.

Lower Harbour of Glasgow.

Seventhly. Deepening, below low-water line the whole of the space in front of the new quay wall below Mr. Napier's Dock.

Eighthly. Deepening the whole of the space below low water, lying opposite Springfield Mill, on the south side of the harbour.

Upper Harbour.

Ninthly. The whole space of the bed of the Clyde, dry at low-water, between the Wooden Bridge and the Stockwell-street Bridge, to be excavated down to low-water line.

> It might be desirable to deepen the upper harbour, so that it might act as a reservoir to receive all the river depositions which are carried down during floods, and thereby diminish as much as possible the depositions which take place in the lower harbour among the shipping. It may be observed that it would be attended with much less inconvenience and expense to dredge them in the upper harbour than in the lower.

The Committee can determine which of these works are most necessary, and how many of them are to be operated upon this season. If the whole force of the five steam-dredgers, with the two diving-bells, be employed the entire of the season, the total expense will be about 14,500*l.*

Proposed Farther Works in Harbour and River.

I have drawn out a general estimate of the probable expense of various farther works, comprising eighteen items, and the Committee can select such of these works for execution as they may deem the most necessary and useful.

I have marked the repairing of the quay wall on the south side, amount 1500*l.*, because my opinion at present, after much consideration, is merely to repair and raise the causeway and shed for the present, as the quay-wall seems to have a greater tendency to sink down than to bulge outwards.

I have also marked the item of expense of the new diving-bell. No. 1 diving-bell boat is old and entirely worn out, and as to attempt to repair her, it would just be making a new diving-bell boat of timber; my opinion is, that it would be much better and cheaper to make a new iron boat—further, I say that every new punt and dredger should be formed of iron, being much more economical, as regards duration and repairs, than wood—less liable to dry-rot, more particularly when the wood punts are constantly floating on fresh water.

The channel of the river Clyde at Dunglass Castle is only 400 feet wide. It would be extremely desirable to have it widened there to a breadth of 640 feet. This would require the river Dyke to be removed southwards 240 feet, for a distance of 2333 yards.

"This was approved of by the trustees at the general meeting, 7th September, 1841."

APPENDIX C

GLASGOW.

No. 343.
Bald, on proposed new Works for improving the Harbour of Glasgow and the Navigation of the River Clyde.

Probable Annual Expense of Five Dredging Boats.

No. 1.	£447	15	0			
2.	564	6	10			
3.	825	19	9			
4.	970	2	11			
5.	1229	19	2			
				£4038	3	8
Annual expense of steam-tug				490	11	1
Do. do. of two diving-bells				516	17	5
Do. amount of coal for the above vessels				774	12	10
Do. do. of oil, grease, &c., for do.				265	10	2
Do. do. of cotton waste for do.				13	7	9
Do. do. of cordage for do.				243	10	10
				£6342	13	9
Annual repairs on the above vessels at Clyde Bank, including repairs of punts				£4000	0	0
White Inch contract				2500	0	0
Dyke repairing				100	0	0
Harbour				1600	0	0
				£14,542	13	9

Proposed Works in Upper Harbour.

Stone quay wall at Stockwell Bridge, 100 feet long, at 11*l.* per foot	£1100	0	0
Stair at Stockwell Bridge, say 100 feet long	1200	0	0
Excavation between Wooden Bridge and Stockwell Bridgr, 266 yards long, 80 yards broad, 1½ yard deep, 266 by 80 by 1·50–31920. at 6*d.*	798	0	0
Removing crane on south side, and putting it up between the bridges in Upper Harbour	79	0	0
Three fish tables, say	25	0	0
	£3202	0	0

Proposed Works in Lower Harbour.

Erecting shed on south side of the harbour, 75 fest long, including slating, gas-work, &c.	£308	0	0
Extension of the Western Steam-boat Wharf, 30 feet long	150	0	0
Erecting six conveniences, at 16*l.* each	96	0	0
Paving shed No. 7, 2581 square yards, at 3*s.* 2*d.*	408	13	2
Stair at Lower Ferry, north side of harbour	100	0	0
Extention of new quay wall at Finnieston, north side of harbour, at 20*l.* per foot	12000	0	0
Crane seat, say about	850	0	0
Erecting new shed on Brownlie's Quay, mooring-pawls, fitting up gas, weigh-house and sewers	1630	0	0
Causewaying Brownlie's Quay, with square dressed whinstone, 185 yards long by 33 yards broad, 185 by 33 = 6105 square yards, at 3*s.* 2*d.*	966	12	6
Rebuilding or repairing quay wall, south side of harbour, 100 feet, at 15*l.*	1500	0	0
	£18,009	5	8

Proposed River Works.

Govan Ferry Quay Wall and Ferry Slip, rendered necessary from cutting off projection	£860	0	0
Drain at White Inch, 470 lineal yards, at 1*l.*, connected with harbour deposits, &c.	470	0	0
New diving-bell, iron shell	300	0	0
	£1680	0	0

Abstract of Proposed Works.

Works in Upper Harbour	£3,202	0	0
Ditto in Lower Harbour	18,009	5	8
River Works as above	1,630	0	0
Total Amount of proposed Works	£22,841	5	8

APPENDIX C.

GLASGOW.

No. 343.
Bald, on proposed new Works for improving the Harbour of Glasgow and the Navigation of the River Clyde.

ANNUAL EXPENSE of maintaining the Depth of Water in the Harbour of Glasgow, and the Navigable Channel of the Clyde; and also the expense of better securing and maintaining the Ship Channel of the River.

	Number of Punt Loads.	Amount for maintaining the Depth of the River. £.	s.	d.	Amount for better securing efficiency in Dredging and Deepening the River. £.	s.	d.
Upper Harbour	3802	.	.		288	19	8
Lower Harbour	7955	610	1	7			
Haugh Head	189	14	6	0			
Salter's Croft	238	14	6	0			
White Inch	166	43	2	9			
North Bar	618	.	.		148	11	0
Erskine Ferry	275	.	.		66	12	4
Ferry Dyke, Bowling	1581	386	5	5			
Bowling	679	95	18	0			
Head of Long Dyke	4470	.	.		680	9	7
Garmoyle	1424	.	.		260	18	0
Port-Glasgow Bank	8047	.	.		1217	9	6
	29,444	1163	19	9	2663	0	1
Coal	..	235	12	3¼	539	0	6¾
Oil, grease, &c.	..	80	15	1	184	15	1
Cotton-waste	..	4	1	6	9	6	3
Cordage	..	74	1	6	169	9	4
Annual repairs (Clyde Bank)	..	1216	12	2	2783	7	10
		2775	2	3¼	6348	19	1¾
Harbour	..	1600	0	0			
White Inch contract	..	2500	0	0			
Repairing dykes	..	100	0	0			
		6975	2	3¼	6348	19	1¾
Steam-tug	..	490	11	1			
Diving-bells	..	.	.		516	17	5
Dredgers whilst idle or being repaired	..	211	3	10			
		£7676*	17	2¼	6865	16	6¾

	£.	s.	d.
Old Work	£7676	17	2¼
Work for better security	6865	16	6¾
TOTAL	£14,542	13	9

WILLIAM BALD.

No. 344.
Bald, Johnstone, and Russell, on the propriety of laying Rails on the Quays of Glasgow, for Mineral Traffic, &c.

No. 344.

Report by WILLIAM BALD, Esq., C.E., *Resident Engineer on the River Clyde;* WILLIAM JOHNSTONE, *Harbour Master; and* JAMES RUSSELL, *Assistant Harbour Master at Glasgow; under a Remit to them from the River Clyde Trustees, as to the propriety of laying Rails on the Quays of Glasgow, for Mineral Traffic, &c., &c.*

GENTLEMEN, *Glasgow, December* 24, 1844.

IN accordance with your remit of the 16th current, we beg leave most respectfully to state that we have carefully considered the plans and projects proposed by the Glasgow Harbour Union Railway Company, for constructing a line of railway along the streets of the quays on the north side of the harbour, extending from the wooden bridge downwards to Mr. Barclay's slip dock; and anxious as we are to encourage any project which would contribute to the increase of the trade of the harbour, we cannot but view the projects of that Company, for reasons which we shall hereafter state, as a measure which would be highly detrimental to the existing general trade of the harbour, consisting of a large American trade, East and West India trade, and, in fact, a trade with almost all the commercial states in the world, together with a very large coasting and steam-boat trade.

We are of opinion that, as your harbour is for general purposes, one portion of the trade should not have facilities or privileges granted to it at the expense of the others; and we are further of opinion, that the measure in contemplation will give facilities to a branch of minor importance, which cannot possibly be enjoyed by the general trade of the port.

This railway, if carried along the quays, whether on the level of the streets or above the sheds upon pillars or arches, it must be obvious, will cause great obstructions to the general trade upon the quays: and the carting thereto can only be diminished insofar as the traffic in coal and other minerals that may be conveyed to the harbour by railway is concerned, and which forms but a very small portion of the general trade of this port.

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* To maintain the present depth of water in the harbour and river, repair the dykes and harbour works, employing the tug and three steam-dredgers, including repairs of punts and dredgers, will (without regard to better efficiency and maintenance of the whole) amount to about 8541*l*., which is 12 per cent. added to 7676*l*., stated above.

No 344.
Bald, Johnstone, and Russell, on the propriety of laying Rails on the Quays of Glasgow, for Mineral Traffic, &c.

A railway elevated only from 12 to 22 feet above the surface of the quays would be an obstruction to the shipment of large machinery and bulky goods.

In referring to the Glasgow Harbour Union Railway plan, it appears that the railway is to be carried from the line of the sheds backwards upon the streets, to a distance of 45 feet from the large crane at the foot of York-street, which will be an obstruction to the general trade. The main streetway at Hyde Park Quay, and the roadway passing along the back of Mr. Napier's dock, will also be seriously interfered with in constructing a railway as delineated in the plan.

As a considerable portion of the quays on the north side of the harbour is in a frail condition, and may, at no distant period, require to be rebuilt, and the line of quay wall straightened with those of Hyde Park Quay, in the event of a railway being erected, it will be necessary to take it down whenever those quays will require to be repaired or rebuilt.

The effects of a coal railway placed over the sheds in which the most valuable goods, costly manufacture, and cargoes of grain are placed, both for export and import, would be highly detrimental to those goods, and to all parties engaged in the shipment thereof, or frequenting the quays; and the quantity of coal-dust incessantly flying about would be found a perfect nuisance

Taking the surface of the railway at 22 feet above the quay coping, at low water there would be a perpendicular fall, from the level of the railway to the hold of a vessel, of more than 40 feet; and it will be seen that large coal placed upon an inclined plane and descending into a vessel from such a height, and also at an angle of so great a declivity, would acquire such an impetus as not only to destroy the coal, but would, in all likelihood, seriously injure the vessel. On the other hand, should it be proposed, instead of using inclined planes, or shoots, to lower the coal in waggons, by drop and back balance, the necessary machinery for this purpose would occupy so large a space of the quays as would be found a great and serious detriment to the trade carried on in the sheds below.

In the event of a railway being placed upon the surface of the present quays, we cannot see how the trade of the harbour could be carried on, on account of the great quantity and multifarious character of the goods, the greater part of which must continue to be transmitted to and from the city by cartage as at present.

The trustees, we respectfully think, ought to consider the interests of the shipping of goods upon which the highest rates are paid, and whether they would be justified in giving a preference by the construction of railways for the transmission of goods which pay only the lowest rate of dues.

It is also our opinion that no joint stock company or private individual should ever be permitted to appropriate any part of the streets of the quays to their own purposes, but that all the works necessary for the accommodation and facility of the general trade of the port, whether by railway or otherwise, should be constructed and upheld by the trustees for the public interest, when they could be removed or altered at the pleasure of the trustees. And we have no hesitation in giving it as our opinion, upon the best consideration, that any line of railway formed on the level of the quays, or suspended over the sheds, would be found incompatible with the general business of the wharfs.

We therefore beg leave most respectfully to suggest that you should refuse your sanction to this railway scheme, as a project which would be highly inconvenient, injurious, and unfair to the general interests of the harbour, as well as establishing a principle the recognition of which may hereafter involve you and your successors in office in great difficulties.

Indeed, the concession of any portion of the quay or harbour property, which had been acquired by the trustees for the benefit of the public of Glasgow and of the surrounding country, to the special use and profit of any railway joint stock company, would, in our opinion, be highly injurious to the interests of this trust.

The proposition which has been made, as we understand, on the part of the Union Railway, to the Clyde trustees, that the works proposed to be erected by them upon the streets of the quays shall be removable at the sight of the trustees, if found inconvenient—we do state, and with great respect, that such a proposition should be regarded with caution by the trustees; for the introduction of such a proposition into the Acts of Parliament, although stated in the most defined and distinct terms, would hereafter, in all likelihood, plunge the trustees into endless litigation and serious expense, before the removal of such works could be enforced.

No railways of any kind are to be seen upon the quays of the docks of Liverpool, Bristol, London, Hull, &c., and where the trade or traffic at those ports is general, like that carried on in the harbour of Glasgow.

As to the coal staiths which have been erected, and which have been stated to this trust as being in operation at Newcastle, Sunderland, North and South Shields, and as forming a precedent for similar erections in the harbour of Glasgow, we beg to observe that such a reference is perfectly delusive, because, be it considered, that at all those coal-shipping places where staiths are in use they do not interfere with such a general trade as exists in the harbour of Glasgow, nor do these coal staith erections interfere with such harbour quay-walls as ours are, or with such ranges of sheds, or with such valuable and general port accommodation as those of the harbour of Glasgow.

With regard to the reference which has also been made to the erected staiths for the shipment of coal at the Hartlepool Dock, this is also delusive, because there is no trade at Hartlepool but an export one of coal, and an import of timber for colliery purposes; it, therefore, cannot be offered as any kind of precedent for the erection of coal staiths in the harbour of Glasgow.

In referring to the Harbour Union Railway plan, there are exhibited not less than 10 coal staiths to be erected along the quay walls, on the north side of the harbour, between Mr. Barclay's building-yard and the wooden bridge; and the coal vessels lying at those 10 staiths will occupy about 1300 lineal feet of the most valuable and most convenient part of the quays of the harbour, to the serious injury of the general trade of the port.

Two of the coal staiths are to be placed on the steam-boat wharfs, near the Glasgow bridge, which will, in our opinion, destroy them for steam-boat passenger purposes; and two more of these coal staiths are to project 30 feet out into the harbour from the breast of the quay walk at Finnieston, which will injure that part of the harbour most seriously.

We again express our sincere hope that the trustees shall never permit a single square inch of either the streets of the quays or the water surface of the harbour to be occupied by coal staiths; and most respectfully advise that no railways of any kind be permitted to be placed upon any part of the sheds, or the streets of the quays of the harbour of Glasgow; but that those railways, with their termini, and also their depôts, shall be placed upon ground adjacent thereto and at a convenient distance

No. 344.
Bald, Johnstone, and Russell, on the propriety of laying Rails on the Quays of Glasgow, for Mineral Traffic, &c.

from the sheds and streets of the quays, so that the traffic may be carried on to or from the harbour in a manner similar to the general traffic which is now carried on in this port.

In concluding, we beg leave to assure the trustees that we have given this measure our deepest and best consideration, and that without prejudice or bias, and also beg to say that we have had a perfect unanimity upon all the points stated in this report.

WILLIAM BALD.
WILLIAM JOHNSTONE.
JAMES RUSSELL.

To the Clyde Trustees.

No. 345.
Extract from "Clyde Police Record," 1845-6.

No. 345.

Extract from "Clyde Police Record."

NUMBER of PERSONS DROWNED and RECOVERED from the RIVER CLYDE, within the bounds of the Harbour of GLASGOW, during the years 1845 and 1846:—

1845—No. of Males drowned	18	21
,, of Females	3	
,, of Males recovered	22	26
,, of Females	4	
Total		47
1846—No. of Males drowned	21	23
,, of Females	2	
,, of Males recovered		21
Total		44

N.B.—The harbour is well supplied with Carter's life-buoys, suspension rope-ladders, and life-books.

Note.—Notwithstanding the immense amount of carting, omnibus and cab driving, &c. &c., upon the quays, during the last twenty-five years, it is worthy of observation that there has not been a single life lost, or even a limb broken.

JAMES RUSSELL.

No. 346.
Captains Bethune and Denison, on the Clyde, &c.

No. 346.

REPORT *by* CAPTAIN BETHUNE, R.N., *and* CAPTAIN DENISON, R.E., *on the Clyde, &c.*

SIR, *London, May* 25, 1846.

IN obedience to the orders of the Lords Commissioners of the Admiralty, communicated in your letter, dated 9th May, directing us to proceed to Glasgow for the purpose of inquiring generally into the state of the River Clyde in the neighbourhood of that town, and particularly as to the contemplated improvements for deepening the river, and the nature of the present obstruction to the flow of the tidal current; also, as to the effect of existing bridges in diminishing the depth of the river, and whether any new railway bridge or bridges could be erected without injurious consequences to its navigation; also, whether the docks proposed to be constructed at Stobcross may be expected to produce benefits sufficient to justify the expense; we beg to state, that we have made inquiries on the spot from those best qualified to give the necessary information; we have inspected the river from Glasgow downwards, in company with the resident engineer; we have seen all the various improvements or alterations which have been made, and which are in course of formation; we have made ourselves acquainted with the works now proposed with the view of improving the navigation of the river, and increasing the amount of accommodation in the harbour, and we have had before us the plans proposed by the different railway companies which in any way affect the river, and having carefully considered all the various points in connection with the subjects submitted to us, we are prepared to report as follows:—

We propose to consider—First, the state of the river, considered as a channel communication to the town and harbour of Glasgow; Secondly, the condition of that part of the river which is more commonly called the harbour of Glasgow, and the works in connexion with it, as well those proposed as those already executed; Thirdly, the effect of the different bridges upon the river, either those existing at present, or those proposed to be erected by the different railway companies.

First. *The State of the River.*—We do not propose to enter into any detailed description of the river, which has been often noticed in the reports of the different engineers who have been consulted as to its improvement. It is sufficient to state, that seventy or eighty years ago it was so choked up with sandbanks and shoals of every description as to render it impossible to bring vessels drawing more than 4 feet, or 4 feet 6 inches of water, up to Glasgow Bridge; while now, vessels of 600 tons, drawing upwards of 17 feet water, are constantly brought up to the harbour without any difficulty.

The most eminent engineers were consulted, and the plan which has produced such beneficial effects upon the state of the river was suggested by Golborne in 1768. The principle upon which he proposed to act was to narrow the channel, and, by thus confining the water, to enable it to act with greater effect upon the bottom, and thus to scour out for itself a channel deeper in proportion as it was narrower. He carried out this principle by constructing jetties from the banks at different distances apart. The ends of these, under the advice of the other engineers, have gradually been connected by parallel dykes, thus forming a regular narrow channel; the action of the tides and freshes has been concentrated between these dykes, and the effect has been to secure a minimum depth of 8 feet at low water at spring tides, and about 17 feet or 17 feet 6 inches at high water. This effect has not been produced wholly by the scour; a large quantity of sand, gravel, &c., has been removed by dredging, and the diving-bell has been employed to remove rock and boulders from the channel.

Mr. James Walker is now engineer to the trustees of the Clyde. In 1836 he made a detailed report to the trustees, which has been since printed, in which he recapitulated most of the propositions of

APPENDIX C.

GLASGOW.

No. 346.
Captains Bethune and Denison, on the Clyde, &c.

the engineers who had been consulted previously, and approved of the plan adopted by Golborne. In 1840 an Act of Parliament was obtained by the trustees, for the purpose of enabling them to carry out the plans proposed by Mr. Walker, the principle of which, as far as regards the river, may be briefly stated as follows:—To straighten generally the course of the river, by cutting away all points and projections which impede the flow of the tide; to carry a gradually increased width from just below the harbour downwards, carrying out the principle of the parallel dykes, only removing them, in some instances, to a greater distance apart, to protect the banks everywhere with stone from the wash of the steamers and action of the floods. At first sight, this gradual enlargement of the channel downwards may appear to be at variance with the original plan of improvements; but it is expected that, by giving to the river this funnel shape, and by removing the impediments to the free run of the tide, there will probably be an increase in the height of the flood tide at Glasgow, and the navigable channel will be rendered more convenient for shipping.

Inasmuch, however, as the channel is to be widened in some places to nearly double its present width, the effect of the scour of the freshes and land floods, which are the main agents for keeping the channel clear, will be lessened, and some diminution of depth may perhaps be the consequence, which will require an additional annual outlay in dredging. Since 1840, the trustees have been gradually carrying out the details of this plan under the advice of Mr. Walker, and it is probable that a great improvement in the river will be the result.

Secondly,—*The State of the Harbour.*—The harbour at present extends below Glasgow Bridge for a distance of 4,800 feet on the north side of the river, and 2,300 feet on the south side, meaning by that, so much of each bank is faced with stone wharfs, and provided with cranes, sheds, and other accommodation for loading or unloading the vessels which lie alongside. Complaints have been made for several years that the extent of wharfage thus provided was insufficient for the wants of the trade, and in 1840 an Act of Parliament was obtained, which, among other provisions for improving the river, gave power to the trustees to extend these wharfs down the river on both banks, and also to construct a dock on the south side, on the spot of ground called Windmillcroft. At present, on the north side, an additional wharfage of 900 feet is in course of construction, in accordance with the provisions of the Act, and land has been purchased on the south side with the view of widening the river, and adding about 3,400 feet of wharfage on this side also, making thus, when the whole shall be completed, an addition of 4,300 feet to the present wharfage accommodation. As little or none of this is yet available, the want of accommodation is still a subject of complaint. Vessels are now lying alongside the wharf five or six in a tier, and the space in the middle between the tiers is but just sufficient to allow the river steamers to wind.

According to the evidence of the harbour-master, it would require about 3,000 feet of additional wharfage to accommodate the present trade to such an extent as to ensure that vessels would never be more than three or four in a tier, or be delayed in loading or unloading, which happens for periods varying from a day to a week.

The addition which is proposed, and which is in course of execution, amounts, as before stated, to 4,300 feet; but of this, 1,200 feet or thereabouts are, by the conditions of the agreement with the General Terminus Railway Company, from whom the land was purchased, to be allotted as a mineral wharf in connexion with the railway, and this extent of wharfage will not, in all probability, be found at all too large a space to be devoted to the increasing mineral traffic which will pour itself into the Clyde when the coal fields in the neighbourhood are opened up by the various railways now in course of construction. Deducting, therefore, this 1,200 feet, there will remain only just enough additional wharfage to accommodate the present trade of the port, without making any allowance for future increase. The Act of 1840, in addition to this amount of wharfage, contemplated, as was before stated, the construction of a dock, for which land has been purchased.

The construction of this dock has, however, been postponed, if not altogether given up, partly on the plea of the nature of the soil, which, it is asserted, will render it expensive and difficult to be constructed, and partly on account of the restricted space, which would limit the amount of the accommodation to be afforded.

We may therefore consider, that so far as the improvements contemplated by the Act of 1840 are concerned, no more accommodation is to be provided than will suffice for the present amount of traffic. The trustees of the Clyde, looking at it in the same point of view, have obtained an Act in the present session of Parliament to enable them to continue the wharfage on the north side of the river for an additional length of 6,600 feet, and a large basin at a place called Stobcross, containing an area of about 17 acres, and affording an extent of about 5,200 feet of wharfage. The ground for these docks has already been purchased, subject to a condition that it is not to be used for any other purposes than the construction of docks. There is no doubt but that this plan, if carried out, will provide ample accommodation for the trade of Glasgow for many years to come. The expense, however, of construction, will be very great,—the cost of the improvement of the river will amount to a large sum. The annual expense of dredging and maintaining the harbour and river will increase for many years, so that it is very doubtful whether the surplus revenue of the trust will be sufficient to defray all the calls upon it, in addition to the large sums that must be borrowed in order to execute the proposed works.

We subjoin a statement of the present revenue and liabilities, together with an estimate of the cost of the various proposed works; and from this it will appear that the present revenue of the trust must be more than doubled, in order to enable the trustees to meet their liabilities when their works shall be completed :—

				£.	*s.*	*d.*
Net amount for 1845				45,868	0	0
Ordinary expenditure, including management and all expenses which can be calculated upon .	£15,385	0	0			
Interest of present debt	11,146	0	0			
Extraordinary expenditure on average of 5 years .	2,000	0	0			
				28,531	0	0
Balance available for new works and repairs				17,337	0	0

Appendix C.

Glasgow.

No. 346.
Captains Bethune and Denison, on the Clyde, &c.

Estimate sent in in 1840 for river and harbour:—		
Land	£200,000 0 0	
Works	600,000 0 0	
		800,000 0 0
Estimate of 1846:—		
Land	105,000 0 0	
Works	600,000 0 0	
		705,000 0 0
		1,505,000 0 0
Deduct land purchased	126,532 0 0	
Works executed	100,468 0 0	
		227,000 0 0
Amount remaining to be spent upon the river and harbour . .		£1,278,000 0 0

To this must be added a large sum for the repairs of the present wharfs, which are in many places giving way, and will require repair or reconstruction. In allowing also 100,468*l.* for new works executed, we have far exceeded the actual sum to be charged against the estimate, as a large portion of the amount has been spent upon works never contemplated in the estimate. We may safely say, then, that to complete the new works, together with the great and increasing repairs to the old wharfs, and the various incidental expenses which must fail upon the trust property from time to time, a sum of from 1,400,000*l.* to 1,500,000*l.* will be required. If Windmillcroft Dock is not to be constructed, a sum of 150,000*l.* may be deducted from this, including the value of the land which has been purchased, but which, if not required for this, will be sold to advantage. Allowing for this, a sum of 1,300 000*l.* will be required, of which the docks at Stobcross are estimated to take 425,000*l.* If this sum is spread over a period of 18 years, an average outlay of 100,000*l* a-year will be required, of which about 90,000*l.* must be borrowed.

	£.	s.	d.
The debt, then, at the end of this period will amount to .	1,170,000	0	0
In addition to the present debt	330,000	0	0
Total debt in 1859	£1,500,000	0	0

The interest of this at 3½ per cent., which is less, probably, than the money can be got for, will amount to 52,000*l.* per annum. If to this be added the ordinary expenditure upon the river and wharfs, which will be increased in proportion to the extent of wharfage, a sum of upwards of 100,000*l.* per annum will be required, in order to enable the trustees to meet their liabilities.

We are, therefore, of opinion, that to commence the construction of the Stobcross Docks at present would create a heavier burden on the trust than it is qualified to sustain; and we are disposed to consider that other and better means may be found by which the necessary amount of accommodation may be procured for the trade.

We allude to the plan of extending the harbour to the eastward. By this plan Glasgow Bridge is to be removed, and replaced by one having a drawbridge in the middle. The space between Glasgow Bridge and Stockwell-street Bridge is to be deepened to the same extent as the lower part of the harbour, to admit the largest vessels. The space above Stockwell-street Bridge will be deepened to admit of small craft, and it will be used as a timber pond, as is the case at present with the space just above Glasgow Bridge. The arguments in favour of this plan are, in the first place, that the wharfage accommodation will be secured in a much shorter time by this means than by constructing the docks. In the second place, the expense will not be one-third that of the docks. In the third place, the trade by it will be brought into the heart of the business part of the town, in the immediate vicinity of the storehouses, instead of being upwards of a mile down the river. The principal objection to it is in the inconvenience which would be felt by the inhabitants, owing to the interruption of the communication across the bridge during the time when the drawbridge must be opened to allow vessels to pass in and out. As this, however, will not amount to more than one hour at the top of high water, and as in most instances even this may be dispensed with during the day, by using the night tide to move the vessels, as is constantly the case at present, and as, moreover, a great part of the traffic is merchandise, we are of opinion that the amount of inconvenience will be too trifling to be put into competition with the advantages held out by the plan. And we give this opinion with more confidence, from finding ourselves supported in it by several of those people connected with the town and harbour, who, from their position, are well qualified to form an accurate judgment both of the benefits to be derived and the inconvenience to be suffered.

Thirdly.—*The effect on the Bridges and River.*—There are at present four bridges across the Clyde within the limits of the city, three of stone and one of wood. The wooden bridge is in a ruinous state, and is to be removed immediately.

Stockwell-street Bridge, which is the centre stone bridge, has the foundation of its piers at so high a level as to render it necessary to secure them by a weir, which also serves the purpose of keeping up the level of the water to the height necessary for the supply of the Glasgow Water-works, at a short distance above the city. This bridge is also about to be pulled down and rebuilt, and the foundations of its piers are to be laid low enough to allow of the deepening of the river to a certain extent, though not to that which we conceive would be advisable. The foundations of Hutcheson Town Bridge are not so low as it is desirable, yet they are low enough not to be interfered with by the partial deepening of the river.

We do not consider that, when these alterations shall have been made, the bridges will have any tendency to injure the bed of the river, or to diminish the depth of water; neither do we consider that a railway bridge, properly constructed, will be likely to act injuriously in this way; but looking to the opinion we have already expressed of the advisability of extending the harbour to the eastward, we should strongly object to the erection of a railway bridge between Glasgow Bridge and Stockwell-street Bridge, which would at once put a stop to any such improvement; for though the Caledonian Company have proposed to insert a clause in their Bill binding them, in case a drawbridge is made in Glasgow Bridge, to construct a similar opening in their own; yet this would manifestly be impossible, without causing an amount of delay and inconvenience to the traffic on the railway which would entirely neutralize the benefit to be derived from it.

APPENDIX C.

GLASGOW.

No. 346.
Captains Bethune and Denison, on the Clyde, &c.

The reasons which have been given in favour of a terminus on the north side of the river do not apply with any very great force to the Caledonian Railway, levels of which are not such as to enable them to carry out any plan of connexion with the railways on the north side. Indeed, from all the evidence we have been able to collect, we are not of opinion that such a connexion is of importance sufficient to warrant the outlay which will be necessary to obtain it.

Should, however, such a joint terminus be considered indispensably necessary, we believe that it could be obtained without injury to the river in any way by crossing it above Stockwell-street Bridge. Having concluded our report upon the matter submitted to us, we beg to lay before their Lordships a brief abstract of the opinions we have formed :—

1st. We are of opinion that the plans for the improvement of the river have been judiciously laid down ; and if the work is carried on in accordance with these plans, the channel is likely to be much improved.

2ndly. That the plans for increasing the harbour accommodation will have the effect of enabling a much greater number of vessels to load and unload without the delays which they at present experience; but that, as far as regards the Stobcross Docks, the advantages to be derived from them will hardly be sufficient to justify the expense. However, as it appears to be advisable that the trustees should have the power now to purchase the land upon which the docks are proposed to be constructed, in case at any future time the increase of trade should be such as to make this additional accommodation necessary, a clause might be inserted in the Act precluding the trustees from commencing the docks until the Lords Commissioners of the Admiralty are satisfied that the funds at their disposal are sufficient to warrant them in commencing such an undertaking.

3rdly. That it is not advisable to allow any railway bridge to cross the harbour below the Stockwell-street Bridge.

4thly. We see no reason to object to the arrangement made with the General Terminus Railway, by the Clyde trustees appropriating a certain portion of the wharfage on the south side of the river to the mineral traffic, providing proper arrangements for shipping the coals, &c., which may be safely left to the engineers employed by the trustees.

We have, &c.,
R. D. BETHUNE, *Captain R.N.*
W. DENISON, *Captain R.E.*

To the Right Hon. H. T. L. Corry, M.P.
Admiralty.

No. 347.

Report by a Committee of the Clyde Trustees relative to the Weir proposed across the Clyde.

Glasgow, September, 1846.

No. 347.
M'Lellan's Report relative to the Weir proposed across the Clyde.

THE Committee believe the present position of the Clyde Trustees, as regards the question of the weir proposed to be erected across the Clyde, is as follows :—From the Act procured last session of Parliament by the Bridge Trustees, containing clauses to the following effect :

1. That the Bridge Trustees are entitled to form a new dam or weir at or about 140 yards above Hutcheson's bridge, having a lock or work therein, or connected therewith, at the expense of the Clyde Trustees.

2. When these works are erected, the Bridge Trustees are then authorised to remove the weir or works placed at the Stockwell-street bridge by the Clyde Trustees, at the Clyde Trustees' expense.

3. The Clyde Trustees are obliged to contribute a sum towards sinking and building the piers and foundations of the new bridge at Stockwell-street. And the Clyde Trustees are obliged to maintain the weir and lock constructed by the Bridge Trustees, at their expense, in all time coming. No detailed plans or estimates exist of the weir and lock. The Act provides that the cost to the Clyde Trustees, of the whole works for which they are made liable, shall be fixed by two engineers or arbiters appointed by the sheriff.

Whether the Clyde Trustees ought to contribute to the building of a bridge over the Clyde, is not within the remit to this Committee; and having stated the present position of the Clyde Trustees as regards the weir, the Committee proceed to the consideration of the effect of the proposed dam or weir upon the navigation of the Clyde.

The Committee believe that all engineers now act upon the principle of giving the greatest possible freedom of admission to the tidal waters, as the best means of improving navigable rivers, the recession of these waters carrying down with them to the sea the alluvial matter held in suspense by the waters of the river; and in proportion to the quantity and velocity of the retiring tidal wave, is the benefit derived from its cleansing and deepening power.

In order to carry out this principle, now well understood and universally acted upon, engineers widen, straighten, and deepen the channel of rivers, from the sea upwards, as far as the tidal wave can be enticed to come, and break up and remove all obstacles to its progress, whether natural or artificial. The tidal wave in the Clyde, according to the report of the late Mr. M'Quiston, confirmed by subsequent observation, can be made to flow seven miles above the city of Glasgow, and give an additional pressure and impetus to the retiring tidal wave of not less than 80 millions of cubic feet of water at ordinary tides; and if the river be properly deepened, even this great quantity of water may be increased. The Committee therefore take leave to recommend that no weir or dam be erected across the Clyde within the reach of the tidal flow.

The Trustees are aware that the largest portion of their stated outlay is upon dredging in the river and harbour; and the Committee are satisfied that a very large proportion of this outlay might be saved by the employment of the powerful natural agency of the tidal waters. The expense of dredging from July 1840, to July 1844, amounted to a very large sum, and it constitutes by much the largest item of our annual expenditure. The heaviest portion of this expenditure was upon the harbour, where dredging is performed at great inconvenience to the shipping and to the business of the port. Nor will it, in the opinion of the Committee, ever be otherwise, until the river above be cleaned and deepened, and a body of water procured sufficient to scour the harbour, which at present serves as a settling pool for the upper waters.

APPENDIX C.

GLASGOW.

No. 347.
M'Lellan's Report relative to the Weir proposed across the Clyde.

It will be said that the Clyde Trustees have no power under their Acts to operate upon the river to the eastward of Stockwell-street bridge, and that their Acts bind them to maintain the present level of the river.

The Committee believe that, if the Clyde Trustees can show that the navigation of the Clyde is to be benefited by an extension of their powers, say for seven miles above the Stockwell-street bridge, penetrating into the heart of the mineral districts, Parliament will grant these powers; and in regard to their obligations to maintain the present level of the river to the east of Stockwell bridge, for the protection of certain public works, the Committee believe that the Clyde Trustees were coerced into the admission of these clauses into their bill, and that there are other and better modes of protecting these works than by a weir across the Clyde. The Committee refer to the analogous circumstances and condition of similar works along the course of the river, beneath the Stockwell-street bridge, because, if a like protection to these public works had been sustained, there could have been no deepening or improvement of the Clyde navigation. The Committee, in short, believe that no public companies, whether constituted by Act of Parliament as Canal Companies, Water Companies, Joint Stock Companies, or private individuals, having works on the banks of a navigable river, using its waters, or having a right of access thereto, can for their interests control or prevent the improvement of a public navigable river, as far as the tidal flow reaches.

From the absence of all detailed plans or descriptions of the works to be erected at the weir, the Committee can give the Trustees no information as to the height or elevation of the intended weir; but from its containing, or being connected with, a lock, the Committee are led to believe that the weir or dam must be elevated to such a height as to enable the lock to be wrought at all times of the tide and in all conditions of the river, or it is evident it must be useless for navigation purposes. The Committee cannot believe that so bold and injurious a measure as the elevation of the channel of the Clyde would be attempted, although there is an indication of such an intention on the very small plan submitted to Parliament; and without such elevation, the works described appear to the Committee to be either useless or impracticable.

The Committee, therefore, take leave to recommend that the Clyde Trustees apply to Parliament next session for powers to open up the navigation of the Clyde to a distance of, say seven miles above the city of Glasgow, to construct all necessary works, and levy such dues as shall be judged fitting and proper. They will thus, in the opinion of the Committee, give great facility for the conveyance of minerals, country produce, and traffic of every description, to and from the harbour; and what is of equal, if not of greater importance, they will, by the recession of the tidal waters, be enabled to keep the whole channel of the river clear at a very moderate expense, and thereby be enabled to devote several thousands a-year, now expended in dredging the river and harbour, to other purposes.

The Committee further recommend that the Clyde Trustees intimate to the Bridge Trustees their intention of going to Parliament next session, in order to prevent the Bridge Trustees from constructing a weir across the river Clyde, with a lock or works therein, and that the Bridge Trustees, in the erection of their bridge, do not in the mean time interfere with the bed of the river, so as to prejudice the Clyde Trustees in their position as regards the Water Company and other parties.

Before concluding their report, the Committee also beg to direct the attention of the Trustees to what is already partially before the Trustees, viz—the attempt upon the part of a Canal Company to take possession of the River Clyde at and above the proposed new weir at Hutcheson's Bridge, and to make additional works in connexion with that weir. The Committee have not been able to procure a sight of the plans of the works which the Canal Company propose to attach to the weir; but as the whole scheme implies the existence and continuance of a weir across the Clyde, the Committee trust the Clyde Trustees will not be consenting parties to any such scheme, but will oppose it with all their power and interest, and compel the Canal Company to terminate their works within the northern line of high water.

And the Committee further recommend that a copy of this report be sent to the Lords of the Admiralty, and another copy to the Tidal Harbours Commissioners.

ARCH. M'LELLAN,
Convener of Committee.

No. 348.

Present and Prospective State of Glasgow Harbour, as to Quay Room and Water Room.

No. 348.
M'Lellan, on the present and prospective state of Glasgow Harbour as to Quay room and Water room.

Glasgow, October 16, 1846.

STATEMENT of the present and prospective Accommodation in the Upper and Under Harbours of Glasgow, and in the Docks authorised to be made by the Act of 1846, exhibited in the length of quay wall.

Existing Quays of Under or Deep Sea Harbour.

	Feet.
Length of quay wall on the north side from Glasgow Bridge westward	4270
Length of quay wall on the south side from Glasgow Bridge westward	2280
Total of quay walls in lineal feet	6550

Existing Quay Wall of Upper Harbour.

Quay wall confined to the north side	520
Total length of quay walls in under and upper harbours, lineal feet	7070

New Quay Walls in process of Erection in the Under Harbour.

North side quay wall, now being executed by Mr. York	892
South side quay wall, now commenced by Mr. Brownlie, contractor	2320
Lineal feet	3212

APPENDIX C.

GLASGOW.

No. 348.
M'Lellan, on the present and prospective state of Glasgow Harbour as to Quay room and Water room.

When these two contracts shall be completed, there will only remain a length of 1500 feet (the lands of which, belonging to Messrs. Hamilton, Blair, and M'Lean, are in process of being acquired by the trustees) of quay wall to be built upon the south side to complete the under harbour, according to the plans of the Act of 1840.

	Feet.
When these lands shall have been acquired and quays built thereon, the under harbour so completed will contain of continuous quay walls	11,262
In the upper harbour the trustees have power to make quays only on the north side, and on the north side there are 520 feet built, 900 feet are still to be built, which will give of quay accommodation in the upper harbour . .	1,420
Length of quay wall in both harbours, lineal feet . .	12,682
Present amount of quay wall	7,070
Leaving of quay wall	5,612

Which will speedily be added to the present accommodation.

The upper harbour contains 13 acres of water.

The under harbour contains at present 30 acres of water; when completed according to the plan of 1840, it will contain 46 acres.

	Feet.
The Act of 1846 empowers the trustees to make docks in the lands of Stobcross, which docks will have an area of 18 acres, and quay walls extending to .	5660
Frontages of Stobcross grounds to Shiner, which frontage may be built up as quay wall	2800
Lineal feet of quay wall on Stobcross grounds	8460
If Windmillcroft Docks be made, they will contain 7½ acres, and of quay wall .	2660

The aggregate of these works would furnish 105 acres of harbour accommodation, and of lineal feet of quay wall 23,802: nearly four times the amount of the present accommodation will be furnished.

A. M'LELLAN, *Clyde Trustee.*

No. 349.

Appendix to Mr. BELL'S *Evidence.*

No. 349.
Appendix to Mr. Bell's Evidence.

SIR, *Glasgow, October* 20, 1846.

IN giving my evidence on the 16th inst., on the subject of the river Clyde, and Glasgow Harbour Trust, I stated that I had not at that time turned my attention to the constitution of the trust, but having since seen a copy of the Report of the Tidal Harbours Commission, of which you are a member, and a copy of a Bill read a first and second time last session of Parliament on the subject of Tidal Rivers and Harbours, I now beg to transmit to you my views on the constitution of the Glasgow Harbour and Clyde Trust.

Up to the year 1700, it appears that the royal burgh of Dumbarton had by an old grant or charter from the Crown, the superiority of the Clyde, then in a state of nature; in which year it was made over or acquired by the corporation of Glasgow, and held by that body till the year 1758, when the River Trust was created by Act of Parliament. This was continued by Act of 1770, the magistrates and council retaining the shore or harbour dues for the common good of the burgh, till the Act of 1809, when the harbour, as well as the river, was vested in the River Trust.

When the first Act of Parliament was obtained, constituting the River Clyde Trust in 1758, the trustees were, the magistrates and council, in number thirty-one, and the Act passed in 1770 continued this. The Act of 1825 authorised the magistrates and council to elect, annually, and add to their number five persons, who, in general, were those who had taken an interest in river and harbour matters, and who had previously acted as town councillors, or were merchants in Glasgow. This constitution was continued till the Act of 1840, when a new constitution was substituted, which, as well as the constitution of the current year, 1846, I altogether disapprove of.

The constitution of 1825, and up to 1840 and 1846, was, in my opinion, much better for the trust than the latter constitutions; and had the trustees acted according to what I considered to be their duty as respects the interests of the river and harbour financially, and otherwise, I would have preferred that constitution to that of 1840 and 1846, with the slight alteration of making the five additional trustees six in number, electing or nominating them for a triennial period—that is, two annually, in place of the whole.

The trust that I would now recommend would be something like the following, viz. thirteen in number; and the mode of appointment or election would not be much dissimilar to what is intended by the Bill intituled "A Bill for the better Management and preservation of the Ports, Harbours, Creeks, Tidal Waters, and Navigable Lakes and Rivers of the United Kingdom of Great Britain and Ireland."

New Trust.

1 The Lord Provost of Glasgow to be chairman *ex officio.*

6 Members to be named from, and elected by, the Town Council of Glasgow (50 in number), of whom the Dean of Guild of the Merchants' House, and the Convener of the Trades' House, may or may not be two. These six members, when chosen as trustees, to remain in office till their period of office, as magistrates or councillors expire, subject to re-election and appointment.

6 Members to be named or elected by the Town Council to be elected for three years (two to be elected annually), but not to be members of the Town Council for the time being. Vacancies from time to time to be filled up by the Town Council, so that the trustees may be 13 in number.

13

APPENDIX C.

GLASGOW.

No. 349.
Appendix to Mr. Bell's Evidence.

I would further suggest, that as an allowance is now always made to railway and other directors, that the sum of 500*l.* sterling should be allowed from the trust funds to those trustees who attend the monthly statutory meetings.

These meetings to be held the first Tuesday of each month, 13 meetings annually . .	£260
Other meetings to be held the third Tuesday of each month, and other meetings, when necessary, to be deemed committee meetings, but all such meetings to be subject to the review of the statutory meetings, held on the first Tuesday of each month .	240
	£500

The paid officers of the Trust to consist of—

1st. A manager, who is to be under the trustees, but to be over all the other officers.
2nd. A treasurer, to be in the manager's office, and subject to him.
3rd. A collector, subject to manager, who is to co-operate with the treasurer.
4th. A resident-engineer, or superintendent of works.
5th. A harbour-master, deputy, and assistants.
6th. A ballast-master.
7th. A clerk or secretary.

The whole of the above officers to have fixed salaries, and to be appointed by, and subject to, the trustees, and removable by them, and all to be subject to the control of the intended Conservancy Board. None of these officers to be allowed any extra charges or remuneration for proceeding to London on business of the Trust, beyond their actual expenses.

I am clearly of opinion that the clerk or secretary, and all the other paid officers of the Trust, should be separate and distinct from the officers of the corporation of Glasgow; and it is well worthy of consideration, whether or not the Bridge Trust of Glasgow should be combined with the River and Harbour Trust.

I have only further to add, that I have perused with care the draft of the intended Conservancy Bill, and that I in general approve of the same; and farther, that, in my opinion, it is peculiarly adapted to, and necessary for, the port of Glasgow and River Clyde Trust.

I remain, &c.,
DAVID BELL.

Captain Washington, R.N.,
Tidal Harbours Commissioner, &c. &c.

No. 350.
Estimate for a Harbour between Jamaica Street and Hutcheson's Bridges.

No. 350.

Estimate to convert the Water Space of the River Clyde between the Jamaica-Street Bridge and the Stockwell Bridge into a Floating Tidal Basin 17 feet deep at Low Water, by W. BALD, Esq., C.E.

UPPER HARBOUR.

Wood, 12*l.* 15*s.*

In Wood.

	£.	s.	d.		£.	s.	d.	Per Foot. £.	s.	d.
2,950 lineal feet of timber wharfs, at . . .	12	15	0	=	37,612	10	0	12	15	0
354,804 cubic yards of excavation, at	0	1	0	=	17,740	4	0			
19,660 square yards of causewaying, at . . .	0	4	0	=	3,932	0	0			
140 mooring-pauls, at	7	10	0	=	1,050	0	0			
983 lineal yards of water-pipes, at . . .	1	5	0	=	1,228	15	0	5	1	5¼
14 cranes, at	150	0	0	=	2,100	0	0			
2,220 lineal feet of sheds, with lamps and gas-pipes, at.	3	0	0	=	6,660	0	0			
					70,323	9	0			
Contingencies, 10 per cent. . . .					7,032	0	0			
26*l.* 4*s.* 5*d.* per lineal foot—total. Total . . .					£ 77,355	9				

Stone, 30*l.*

In Stone Work.

Quay-walls to be 32 feet high, depth 17 feet at low water.

	£.	s.	d.		£.	s.	d.	Per Foot. £.	s.	d.
2,950 lineal feet of stone quay-walls, at . . .	30	0	0	=	88,500	0	0	30	0	0
484,560 cubic yards of excavation, at	0	1	0	=	24,228	0	0			
19,660 square yards of causewaying, at . . .	0	4	0	=	3,932	0	0			
140 mooring-pauls, at	7	10	0	=	1,050	0	0			
983 lineal yards of water-pipes, at . . .	1	5	0	=	1,228	15	0	5	1	5¾
14 cranes, at	150	0	0	=	2,100	0	0			
2,220 lineal feet of sheds, with lamps and gas-pipes, at.	3	0	0	=	6,660	0	0			
					127,698	15	0			
Contingencies, 10 per cent. . . .					12,769	0	0			
47*l.* 12*s.* 3¾*d.* per lineal foot—total. Total . .					£ 140,467	15	0			

If a drawbridge were made in the Stockwell Bridge, then the water-space up to Hutcheson's Bridge, containing seven acres, might be also converted into a harbour 17 feet deep at low tide: the length of quays would be 1710 feet, and would cost as follows:—

	£.	s.	d.		£.	s.	d.
In wood, 1710 feet, at	26	4	5	=	44,837	12	6
In masonry, at	47	12	3¾	=	81,422	14	4½

APPENDIX C.

GLASGOW.

No. 350.
Estimate for a Harbour between Jamaica Street and Hutcheson's Bridge.

	Length of Quay in Feet.	Amount of Expense in Wood. £.	s.	d.	Amount of Expense in Masonry. £.	s.	d.	Area in Acres.
Between Jamaica-Street Bridge and Stockwell Bridge	2,950	77,355	9	0	140,467	15	0	15½
Between Stockwell Bridge and Hutcheson's Bridge	1,710	44,837	12	6	81,422	14	4	7
	4,660	122,193	1	6	221,890	19	4	22½

No. 351.

No. 351.
Estimate for a Tidal Basin at Stobcross.

Estimate for constructing a Tidal Basin at Stobcross, to contain 32 *acres of water, and to be* 17 *feet deep at low water, with a lie-by for vessels of eight acres, in all containing an area of* 40 *acres of surface water, and which will give a tidal scour of* 12,196,800 *cubic feet of water.*

STOBCROSS TIDAL HARBOUR.

Wood, 12*l.* 15*s.*

In Wood.

	£.	s.	d.		£.	s.	d.	Per lineal Ft. £.	s.	d.
2,061,780 cubic yards of excavation, at . . .	0	1	0	=	103,657	10	0			
8,130 lineal feet of timber wharfs, at . . .	12	15	0	=	97,560	0	0	12	15	0
89,628 square yards of causewaying, at . . .	0	4	0	=	17,925	12	0	5	0	0¾
300 mooring-pauls, at	7	10	0	=	2,250	0	0			
25 cranes, at	150	0	0	=	3,750	0	0			
2,716 lineal yards of water-pipes, at . . .	1	5	0	=	3,395	0	0			
4,450 lineal feet of sheds, gas-pipes, and lamps, at .	3	0	0	=	13,350	0	0			
					241,888	2	0			
Contingencies, 10 per cent. . . .					24,188	0	0			
32*l.* 15*s.* 7*d.* per lineal foot—total. Total . .					£266,076	2	0	Exclusive of land.		

8,130 lineal feet of timber wharfs.
40 acres of area of water-space.
17 feet deep at low water.
370 ships averaging 300 tons can be accommodated.
12,196,800 cubic feet of water will be given for a tidal scour.
266,076*l.* expense for constructing the works, exclusive of land.

Stone, 30*l.*

In Stone.

	£.	s.	d.	Per lineal Foot. £.	s.	d.
2,419,500 cubic yards of excavation, at 1*s.*	120,975	0	0			
8,130 lineal feet of quay-walls 33 feet high, at 30*l.*	243,900	0	0	30	0	0
Paving	17,925	0	0	5	0	0¾
Pauls	2,250	0	0			
Cranes	3,750	0	0			
Water-pipes	3,395	0	0			
Sheds	13,350	0	0			
	405,545	0	0			
Contingencies, 10 per cent. . . .	40,554	0	0			
53*l.* 12*s.* 10½*d.* per lineal foot—total. Total . .	£446,099	0	0	Exclusive of land.		

Until the spaces of water between the bridges at Glasgow shall have been converted to harbour purposes, and the lower harbour of Glasgow and the Windmillcroft tidal basin completed, there is not the slightest necessity for making docks or a tidal harbour at Stobcross.

WILLIAM BALD, *Civil Engineer.*

No. 352.

No. 352.
Arbiters' award.
Clyde Trustees against Bridge Trustees.

Note of Arbiters. In Submission. Clyde Trustees against Bridge Trustees.

Glasgow, November 19, 1846.

THE arbiters, having heard parties fully, and considered the evidence, are of opinion that any further proof is unnecessary. They have themselves repeatedly examined the Stockwell Street Bridge, and the state of the river between it and the Jamaica Street Bridge; and having been appointed arbiters from their professional acquaintance with all such matters, they think that no benefit could be derived from additional evidence.

With regard to the leading matters submitted to them:—

1st. They have come to be of opinion that a sum of 8100*l.*, with an addition of 20 per cent., should be paid by the trustees for the navigation of the river, for the expense of sinking to an additional depth the foundations of the new Stockwell Street Bridge, in terms of the 10th section of the statute 8 Victoria, cap.   , and of removing the weir at the Stockwell Street Bridge, and constructing the new weir instead thereof, in terms of the 12th section of the said statute. Originally they had fixed the sum at 8100*l.*, but, in consequence of the increase both on the price of materials and rate of wages since the estimate on which they proceeded was prepared, they think that an addition of 20 per cent. should be added to it.

APPENDIX C.

GLASGOW.

No. 352.
Arbiters' award.
Clyde Trustees against Bridge Trustees.

2nd. They are of opinion that one-fourth of the cost (exclusive of the above specified allowance for foundations and weirs) of a stone bridge of five arches, conformable to a design to be approved of by the bridge trustees, should be paid by the trustees for the navigation of the river, and that the remainder shall be paid by the bridge trustees. In the whole circumstances of the case they conceive that the proportions of the expense thus fixed are just and equitable.

3rd. They are of opinion that the trustees for the navigation of the river are not bound, and cannot be required, to make any additional contribution or compensation to the bridge trustees for the continuance of the exemption from payment of tolls and pontage duties.

4th. They are of opinion that no additional works are necessary for the security of Hutcheson's Bridge, as they think that the works contemplated by the Bridge Act may be completed consistently with its safety.

JAMES WALKER.
JAMES SMITH.

Order.

THE arbiters allow these notes to be seen by the parties for fourteen days from this date, with certification that if no objections be lodged with the clerk within that time an award will be extended in conformity therewith.

JAMES WALKER.
JAMES SMITH.

No. 353.
Custom Duties, &c. from 1811 to 1846.

No. 353.

Customs.—Account of Duties collected at the Port of Glasgow, and the Registered Shipping belonging thereto.

Years.	Amount of Duties.			Shipping.		Remarks.
				No.	Tons.	
	£.	*s.*	*d.*			
1811	3,124	2	4	35	2,620	Population of city, 100,749.
1812	7,511	6	5	45	3,400	
1813	7,419	12	8	50	3,676	
1814	8,300	4	3	59	4,829	
1815	8,422	9	2	63	4,922	
1816	8,890	18	1	69	5,728	
1817	6,802	1	3	70	5,623	
1818	8,384	3	4	74	5,523	Bonding system, partially extended to Glasgow.
1819	11,000	6	9	85	6,604	
1820	11,428	9	0	77	6,131	
1821	16,147	17	7	90	6,605	Population, 147,043.
1822	22,728	17	2	94	7,916	Bonding further extended.
1823	29,926	15	0	94	8,979	
1824	41,154	6	7	111	14,084	
1825	78,958	13	8	186	31,089	Transference to Customs of Excise Import Duties.
1826	71,922	8	0	219	36,048	
1827	74,255	0	1	222	35,911	
1828	70,964	8	4	220	36,965	Approved as an East India port.
1829	59,013	17	3	233	40,978	
1830	72,053	17	4	217	39,432	
1831	68,741	6	9	223	39,900	Population, 202,426.
1832	97,041	11	11	244	41,744	
1833	166,913	3	3	275	49,437	Approved for tobacco.
1834	270,667	8	9	297	54,335	Approved for tea.
1835	314,701	10	8	316	59,151	
1836	389,702	2	10	312	59,123	
1837	894,144	11	8	313	60,759	
1838	403,904	17	9	331	55,977	
1839	468,974	12	2	351	71,878	
1840	472,563	19	9	403	85,707	
1841	526,100	0	11	431	95,062	Population, 282,462.
1842	503,871	11	9	451	101,786	
1843	497,728	10	2	455	108,121	
1844	551,851	2	5	472	111,620	
1845	589,527	15	0	512	130,001	
1846	631,805	14	8	512	134,603	Estimated population, 330,000.

No. 354.
Grounds purchased by the Clyde Trustees, 1831-46.

No. 354.

Grounds purchased by the River Clyde Trustees, 1831–46.

Year.	From whom purchased.	Where Situated.	Number on Parliamentary Plan of 1840.	Total Extent of Ground in Square Yards.	Extent of Alveus Ground in Square Yards.	Total Amount Paid. £.	s.	d.
1831	Robert Thompson, of Camphill, and others.	Steamboat quay, North side.	1	4,804	372	3,896	19	4
1832	The Magistrates and Council of the City of Glasgow.	Windmillcroft, waterside ground, South side.	50	29,808	11,400	7,770	0	0
1833	William Stirling Crawford, of Milton.	Overnewton, North side .	8	6,328	4,714	491	6	9
1834	The Trustees of the Rev. Andrew Whyte.	Salterscroft, Goran, South side.	85, 94	27,576	7,700	1,586	6	0
,,	Charles Paterson and others.	Steamboat quay, North side, opposite Clyde St.	..	3,654	650	3,349	5	3
1835	John Hair and others . .	West Shiells, South side	110, 111	..	..	109	6	6
,,	Mrs. Jean Rowan and others.	Govan, South side . .	96	596⅓	596⅓	34	6	0
	Alexander Gray, Trustee on the sequestrated estate of James and Alexander M'Gregor.	Kelvinhaugh, North side.	11	190	190	14	13	6
1837	James Meiklam, of Carnbroe.	Hydepark, North side .	1	5,671	1,605	7,088	15	0
1831	James Smith and George Murray.	Whiteinch, North side .	149—152	37,879	24,120	2,347	17	3
1839	The City of Glasgow .	Windmillcroft, South side	49	54,278⅔	..	43,196	10	2
1841	Gavin Hardie . . .	Lancefield, North side .	4	7,606⅔	888	11,325	11	3
	Mrs. Alexander Johnston	Ditto	3	3,925	1,441	5,563	0	0
	Charles Tod, and Higginbotham, and Charles Tod's Trustees.	Springfield Works and ground, East side.	54	7,060	..	52,243	0	0
1842	Trustees of Charles Tod	Springfield, South side .	53, 55	4,153½	..	5,035	8	9
1843	Mrs. Graham Gilbert . .	Govan Ferry, North side.	12, 17	7,789	..	2,434	1	3
	James Lumsden and others	Between bridges, North side.	250, 253	12,529	..	2,369	15	3
	Thomas Wingate . .	Springfield, South side .	56, 57	8,130	2,046¼	10,863	0	0
	Robert Napier . . .	Lancefield dock, North side.	2	2,482	1,700	8,000	0	0
1844	William Niven and others	Finniston, North side . .	5	18,321⅐	5,511	15,450	12	9
1845	Mr. Crawford, of Milton	Over Newton, North side	8, 9, 10	14,480	1,307	4,665	8	9
1846	Messrs. Connell and Wright.	Parkholm, South side .	58, 59	16,689⅞	873	19,436	10	0
	Stobcross proprietors . .	Stobcross, North side .	7, &c.	155,285	5,285	63,750	0	0
1846	The General Terminus Railway Company, Glasgow.	Parkhouse, South side .	60, 61, 62	10,332	69⅛	11,288	4	0
,,	The General Terminus Railway Company, Glasgow.	Greenlaw, South side . .	63, 64	8,223⅞	269⅛	8,352	1	0
,,	The General Terminus Railway Company, Glasgow.	Ditto	63, 65, 66	18,877⅞	370	15,268	18	4
,,	Mr. Crawford, of Milton	Over Newton, North side.	10, 136	81,259	319⅝	*		
				429,029⅞	27,426⅓	266,930	17	1
						40,789	6	8†
						397,729	3	

* Annual Feu duty of £2,039 9*s*. 4*d*.

† Principal of Feu duty, at 5 per cent.

No. 355.
Comparative Statement of Foreign Arrivals and Departures.

No. 355.

Comparative Statement of Foreign Arrivals and Departures in 1828 *and* 1845, *and Nine Months in* 1845, *with the corresponding Nine Months in* 1846.

	No. of Vessels.	Total Vessels.	Tonnage.	Total Tonnage.
1828, Arrivals	89		9934	
,, Departures	61		7295	
	—	150	—	17,229
1845, Arrivals	374		88,108	
,, Departures	486		111,936	
	—	860	—	200,044
Increase of 1845 over 1828 . .		710		182,815
1845, Arrivals for 9 months ending September	272		69,981	
,, Departures ,, ,,	389		92,346	
	—	661	—	162,327
1846, Arrivals ,, ,,	278		62,876	
,, Departures ,, ,,	559		109,699	
	—	837	—	172,075
Increase of 1846 over 1845		176		9,748

On the 30th July, 1846, there were 63 vessels to and from foreign ports lying in the harbour, with an aggregate tonnage of 17,401 tons.

No. 356.

Abstract of Shipping which arrived at the Harbour of Glasgow, commencing at the 9th of July, and ending with the 8

Years.	Sailing and Steam Vessels.	Under 40 Tons.	Total.	40 to 60	Total.	60 to 80	Total.	80 to 100	Total	Total Sailing and Steam Vessels at 100 Tons and Under	100 to 150	150 to 200	200 to 250	250 to 300	300 to 350	350 to 10
1832	Sailing .	1,839	..	1,125	..	694	..	290	..	3,948	190	21	3	..	..	..
	Steam . .	159	..	1,497	..	4,167	..	1,120	..	6,943	295	227	95	..	..	..
			1,998		2,622		4,861		1,410	..						
1833	Sailing .	1,849	..	968	..	778	..	334	..	3,929	203	13	2	..	..	..
	Steam . .	27	..	1,407	..	4,188	..	1,197	..	6,819	431	244	116	..	..	..
			1,876		2,375		4,966		1,531	..						
1834	Sailing .	1,994	..	1,053	..	847	..	365	..	4,259	216	33	6	2	..	..
	Steam . .	..	..	1,616	..	4,273	..	1,533	..	7,422	498	283	164	..	..	..
			1,994		2,669		5,120		1,898	..						
1835	Sailing .	2,128	..	1,166	..	831	..	337	..	4,402	252	62	15	11	1	..
	Steam . .	121	..	1,270	..	4,208	..	1,533	..	7,132	820	331	109	9	..	..
			2,249		2,376		5,039		1,870	..						
1836	Sailing .	1,969	..	1,160	..	856	..	369	..	4,354	315	108	11	9	1	..
	Steam .	292	..	1,283	..	4,541	..	1,515	..	7,631	880	278	188	105	..	..
			2,261		2,443		5,397		1,884	..						
1837	Sailing .	1,872	..	1,139	..	408	..	291	..	3,710	286	73	14	14	7	4
	Steam . .	389	..	857	..	4,041	..	1,811	..	7,098	781	114	299	181	..	58
			2,281		1,996		4,449		2,102	..						
1838	Sailing .	2,800	..	1,273	..	393	..	272	..	4,238	217	93	30	13	7	1
	Steam . .	573	..	1,671	..	3,520	..	1,452	..	7,416	869	144	275	191	..	99
			2,873		3,144		3,913		1,724	..						
1839	Sailing .	2,725	..	1,514	..	429	..	326	..	4,994	295	113	41	24	17	8
	Steam . .	456	..	2,259	..	3,000	..	2,513	..	8,228	682	139	188	173	36	119
			3,181		3,773		3,429		2,839	..						
1840	Sailing .	2,841	..	1,303	..	324	..	293	..	4,761	289	158	31	36	27	21
	Steam . .	415	..	2,983	..	3,621	..	2,682	..	9,701	633	168	140	248	60	97
			3,256		4,288		3,945		2,975	..						
1841	Sailing .	3,041	..	1,335	..	416	..	322	..	5,114	298	197	50	50	32	22
	Steam . .	391	..	2,630	..	2,342	..	2,817	..	8,180	601	95	129	185	49	51
			3,432		3,965		2,758		3,139	..						
1842	Sailing .	2,896	..	997	..	343	..	202	..	4,438	247	166	80	42	27	27
	Steam . .	348	..	2,199	..	1,895	..	2,612	..	7,054	494	80	109	238	7	41
			3,244		3,196		2,238		2,814	..						
1843	Sailing .	3,287	..	1,021	..	288	..	271	..	4,867	221	212	54	55	31	24
	Steam . .	562	..	2,235	..	1,674	..	2,748	..	7,210	589	67	115	235	9	32
			3,849		3,258		1,962		3,019	..						
1844	Sailing .	3,361	..	997	..	274	..	235	..	4,867	213	206	52	40	33	19
	Steam . .	569	..	1,945	..	1,817	..	2,574	..	8,905	634	55	93	194	6	52
			3,930		2,942		2,101		2,809	..						
1845	Sailing .	3,192	..	981	..	311	..	277	..	4,761	220	211	59	65	48	32
	Steam . .	495	..	1,819	..	2,308	..	2,328	..	8,950	624	239	107	314	2	47
			3,687		2,800		2,819		2,805	..						
*184	Sailing .	3,232	..	1,037	..	529	..	329	..	5,127	261	245	101	53	62	28
	Steam . .	579	..	1,461	..	2,566	..	2,234	..	6,840	805	165	120	228	31	87
			3,811		2,498		3,095		2,583	..						

NOTE.—Previous to the 26th February, 1830, the draft of water of the sailing vessels, arriving or departing, was not recorded in the books of the Harbour Office. The draft of steamers, average draft, 4¼ feet. 2nd. Sea-going steamers, average

* The end of the Clyde Trustees' financial year having been changed from the 8th of July to the 30th of June in 1846, the year has only been brought up to the latter date.

Glasgow, October 15, 1846.

July, for the Years 1832–46; and of the Number of Sailing Vessels drawing Six Feet of Water and upwards during that period.

450 to 500	500 to 600	600 to 700	Total Sailing and Steam Vessels exceeding 100 Tons and Upwards	Total Sailing and Steam Vessels.	Total Arrivals of Sailing and Steam Vessels.	Total Tonnage of Sailing and Steam Vessels.	Grand Total of Tonnage.	Number of Sailing Vessels drawing Six Feet of Water and upwards. 6	7	8	9	10	11	12	13	14	15	16	17	18	19
..	..	..	214	4,162	..	194,831	..	365	1,283	436	362	228	197	33	17	..	..	..	..	..	..
..	..	..	617	7,560	..	548,973	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					11,722		743,804														
..	..	..	218	4,147	..	190,678	..	372	1,365	465	298	245	182	42	14	..	1	..	..	..	..
..	..	..	791	7,610	..	578,247	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					11,757		768,925														
..	..	..	257	4,516	..	211,464	..	302	1,385	385	338	263	220	35	21	4	..	..	..	..	..
..	..	..	945	8,367	..	616,059	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					12,833		827,523														
..	..	..	341	4,743	..	222,759	..	386	1,396	424	307	237	274	50	25	7	4	1	..	..	..
..	..	..	1,269	8,401	..	688,568	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					13,144		911,327														
..	..	..	445	4,799	..	244,610	..	215	1,467	392	362	297	219	68	35	14	6	..	..	..	..
..	..	..	1,451	9,082	..	718,044	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					13,881		962,654														
2	..	..	406	4,116	..	211,318	..	386	1,354	425	344	275	209	112	35	22	9	1	..	..	..
..	..	..	1,433	8,531	..	718,414	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					12,647		929,732														
1	1	1	365	4,603	..	214,471	..	597	1,308	443	320	237	204	103	58	23	5	4	2	..	..
..	..	..	1,593	9,009	..	731,028	..	..	..	..	..	..	..	..	..	..	..	..	..	.	..
					13,612		945,409														
..	..	..	500	5,494	..	269,302	..	663	1,467	537	363	332	185	144	80	27	15	2	2	..	..
..	..	..	1,390	9,627	..	785,745	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					15,121		1,055,047														
2	4	..	576	5,337	..	271,942	..	812	1,400	473	350	215	187	125	72	46	27	9	..	..	..
..	..	..	1,448	11,149	..	894,387	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					16,486		1,166,329														
3	3	3	671	5,765	..	314,268	..	693	1,564	551	436	335	201	136	80	59	32	15	3	..	..
15	66	..	1,241	9,421	..	828,171	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					15,206		1,142,373														
10	7	6	611	5,049	..	275,769	..	596	1,279	405	289	201	148	124	66	24	40	14	9	1	..
..	94	2	1,139	8,193	..	754,714	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					13,242		1,030,483														
5	17	11	651	5,518	..	299,530	..	765	1,199	383	303	253	173	132	63	40	31	15	8	..	..
..	106	1	1,212	8,431	..	768,871	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					13,949		1,058,401														
7	7	5	598	5,465	..	272,198	..	1,093	988	326	307	190	183	104	36	31	23	14	3	3	..
..	124	..	1,225	8,130	..	740,071	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					13,595		1,012,269														
13	17	11	701	5,462	..	312,525	..	1,332	888	394	320	237	196	115	60	56	59	31	10	1	..
..	120	..	1,507	8,457	.,	769,424	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					13,919		1,101,949														
10	11	2	797	5,924	..	342,735	..	1,116	943	470	414	330	205	170	86	51	56	24	18	..	1
..	83	..	1,555	6,395	..	775,233	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
					14,319		1,117,968														

ater of the steam vessels arriving at the harbour it has not been considered necessary to record, they being nearly all regular traders, and may be put into three classes —1st. River
aft, 4 feet. 3rd. Sea going steamers, average draft, 12 feet.

WILLIAM JOHNSTONE, *Harbour Master.*

APPENDIX C.

GLASGOW.

No. 357.

Statement of Revenue, Expenditure, and Debt, 1770 1846.

No. 357.

Statement of the Revenue, and Expenditure, and Debt of the Trustees for improving the Navigation of the River Clyde, and Enlarging the Harbour of Glasgow, from 1770 *till July*, 1845, *and June*, 1846.

—	Revenue.			Expenditure.			Surplus.			Deficiency.			Debt.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	.	d.	£.	s.	d.
To July 1770 . .	147	0	10	2,680	4	11	.	.		2,533	4	1	2,533	4	1
,, 1771 . .	1,044	10	0½	1,749	10	8	.	.		705	0	7½	3,238	4	6½
,, 1772 . .	1,220	1	9¾	3,745	3	9½	.	.		2,526	1	11¾	5,763	6	8½
,, 1773 . .	1,494	1	0	4,765	7	4¾	.	.		3,271	6	4¾	9,034	13	1
,, 1774 . .	1,454	4	4	5,426	9	10	.	.		3,972	5	6	13,006	18	7
,, 1775 . .	402	3	7½	4,909	5	9	.	.		4,507	2	1½	17,514	0	8½
,, 1776 . .	1,984	0	7	5,157	6	9½	.	.		3,173	6	2½	20,687	6	11
,, 1777 . .	1,397	0	7½	1,430	18	6½	.	.		33	18	1	20,721	5	0
,, 1778 . .	1,733	19	4½	1,358	9	7½	375	9	9	.	.		20,345	15	3
,, 1779 . .	1,540	1	8	2,505	17	9¾	.	.		965	16	1¾	21,311	11	4¾
,, 1780 . .	1,515	8	4	1,509	0	0¼	6	8	3¾	.	.		21,305	3	1
,, 1781 . .	1,721	5	8	1,435	3	4	286	2	4	.	.		21,019	0	9
,, 1782 . .	1,420	16	8	1,437	11	3	.	.		16	14	7	21,035	15	4
,, 1783 . .	1,450	16	8	1,432	0	5½	.	.		81	3	9½	21,116	19	1½
,, 1784 . .	1,120	0	0	1,704	6	2½	.	.		584	6	2½	21,701	5	4
,, 1785 . .	3,256	18	10	1,646	6	1¾	1,608	10	8½	.	.		20,092	14	7¾
,, 1786 . .	1,980	14	10	1,526	18	2½	453	16	7½	.	.		19,638	18	0¼
,, 1787 . .	1,975	16	4	1,548	7	9¾	427	8	6¼	.	.		19,211	9	6
,, 1788 . .	2,064	5	9	1,569	6	3½	494	19	5½	.	.		18,219	1	8
,, 1789 . .	2,154	15	6	1,657	7	1¾	497	8	4½	.	.		17,864	18	5½
,, 1790 . .	2,239	0	4	1,884	17	1½	354	3	2½	.	.		17,864	18	5½
,, 1791 . .	3,175	14	1	2,245	19	9	929	14	4	.	.		16,935	4	1½
,, 1792 . .	2,739	5	7	2,329	5	6	410	0	1	.	.		16,525	4	0½
,, 1793 . .	2,840	17	11	2,887	6	9	.	.		46	8	10	16,571	12	10½
,, 1794 . .	2,936	14	11	2,976	9	9½	.	.		39	14	10½	16,611	7	9
,, 1795 . .	2,836	5	9	2,639	7	2	196	18	7	.	.		16,414	9	2
,, 1796 . .	3,649	14	4	2,680	16	8	968	17	8	.	.		15,445	11	6
,, 1797 . .	3,182	6	0	2,517	5	7	665	0	5	.	.		14,780	11	1
,, 1798 . .	3,199	1	6	2,355	10	10	843	10	8	.	.		13,937	5	0
,, 1799 . .	3,233	18	3	1,713	12	8	1,520	5	7	.	.		12,416	14	10
,, 1800 . .	3,319	16	1	1,904	8	8	1,415	7	5	.	.		11,001	7	5
,, 1801 . .	3,400	10	9	2,558	6	8	842	4	1	.	.		10,159	3	4
,, 1802 . .	4,085	15	11	3,177	5	7	908	10	4	.	.		9,250	13	0
,, 1803 . .	4,640	16	10	2,322	2	3	2,318	14	7	.	.		6,931	18	5
,, 1804 . .	4,193	7	7	2,495	14	8	1,697	12	11	.	.		5,234	5	6
,, 1805 . .	4,065	10	5	2,977	6	5	1,088	4	0	.	.		4,146	1	6
,, 1806 . .	4,299	14	3	3,055	0	2	1,244	14	1	.	.		2,901	7	5
,, 1807 . .	5,000	5	9	3,775	9	4	1,224	16	5	.	.		1,676	0	11
,, 1808 . .	5,472	0	9	3,917	16	9	1,554	4	0	.	.		1,222	7	0
,, 1809 . .	5,407	9	8	5,457	17	0	.	.		50	7	5	172	14	5
,, 1810 . .	6,676	7	6	35,210	9	7	.	.		28,534	2	1	28,706	16	6
,, 1811 . .	4,755	3	8	11,347	16	0	.	.		6,592	12	4	35,299	8	10
,, 1812 . .	4,597	19	7	11,617	11	1	.	.		7,019	11	6	42,319	0	4
,, 1813 . .	5,169	13	9	12,247	15	6	.	.		7,078	1	9	49,397	2	1
,, 1814 . .	5,275	6	11	9,542	7	0	.	.		4,267	0	1	53,664	2	2
,, 1815 . .	5,902	2	8	7,128	8	3	.	.		1,226	5	7	54,890	7	9
,, 1816 . .	5,843	7	8	4,977	12	5	865	15	3	.	.		54,024	12	6
,, 1817 . .	7,028	0	7	5,286	3	2	1,741	17	5	.	.		52,282	15	1
,, 1818 . .	7,732	18	11	5,520	9	0	2,212	9	5	.	.		50,070	5	8
,, 1819 . .	7,386	2	10	6,300	2	8	1,086	0	2	.	.		48,984	5	6
,, 1820 . .	6,328	18	10	7,076	12	2	.	.		747	13	4	49,731	18	10
,, 1821 . .	8,070	2	2	7,516	2	0	554	0	2	.	.		49,177	18	8
,, 1822 . .	7,984	3	8	6,909	7	6	1,074	16	2	.	.		48,103	2	6
,, 1823 . .	8,380	16	4	7,989	7	4	391	9	0	.	.		47,711	13	6
,, 1824 . .	8,555	0	0	15,194	4	3	.	.		6,639	4	3	44,350	17	9
,, 1825 . .	8,367	11	7	9,774	6	4	.	.		1,406	14	9	55,757	12	6
,, 1826 . .	16,204	6	6	15,985	11	2	218	15	4	4,825	18	4*	60,364	15	6
,, 1827 . .	14,316	16	9	33,757	12	4	.	.		19,440	16	7	81,289	7	8
										1,483	15	7*			
,, 1828 . .	17,669	14	10	41,033	18	0	.	.		23,364	3	2	107,914	8	8
										3,260	17	10*			
,, 1829 . .	20,194	10	4	20,851	12	11	.	.		657	2	7	108,674	16	4
										103	5	1*			
,, 1830 . .	20,296	18	6	24,821	8	8	.	.		4,524	10	2	113,947	2	8
										747	16	2*			
,, 1831 . .	18,932	0	7	24,879	11	3	.	.		5,947	10	8	121,552	3	1
										1,657	9	9*			
,, 1832 . .	22,496	0	3	23,962	15	1	380	1	11*	1,466	14	10	122,638	16	0
,, 1833 . .	21,578	5	2	24,908	4	8	.	.		3,329	19	6	126,250	8	0
										281	12	6*			
,, 1834 . .	22,859	14	10	20,561	12	8	2,298	2	2	1,279	10	0*	125,231	15	10
,, 1835 . .	31,910	19	3	29,609	13	11	2,301	5	4	1,073	8	3*	124,003	13	9
,, 1836 . .	35,612	16	0	40,024	1	10	.	.		4,411	5	10	129,882	10	5
										1,467	10	10*			
,, 1837 . .	35,595	8	5	49,585	19	9	409	0	7*	13,990	11	4	143,464	1	2
,, 1838 . .	37,028	13	0	48,343	7	0	.	.		11,314	14	0	157,660	13	9
										2,881	18	7*			
,, 1839 . .	45,826	13	5	35,694	17	4	10,131	16	1	3,944	12	2*	151,473	9	10
,, 1840 . .	46,742	1	7	44,356	4	1	2,385	17	6	484	6	10*	149,571	19	2
,, 1841 . .	50,666	19	2	70,248	13	7	490	11	4*	19,581	14	5	168,663	2	3
,, 1842 . .	40,678	16	8	91,456	4	5	321	8	7*	50,777	7	9	219,119	1	5
,, 1843 . .	45,709	9	9	108,160	11	6	.	.		62,451	1	9	282,416	1	0
										845	17	10*			
,, 1844 . .	43,841	9	4	81,219	7	7	396	15	0*	37,377	18	3	319,397	4	3
,, 1845 . .	45,870	5	10	50,113	18	1	3,635	4	1*	4,243	12	3	320,005	12	5
June 1846 . .	51,198	12	2	81,230	18	0	2,631	4	2*	30,032	5	10	347,406	14	1
Totals	898,280	17	1¼	1,229,614	2	1¾	55,559	12	1½	403,266	6	2¾			
Amount of debt .	347,406	14	1												
	1,245,687	11	2¾												
Add receipts not accounted for .	8,264	5	8	24,337	14	9	Amount expended, but not included in the expenditure.								
Total expenditure.	1,253,951	16	10¾	1,258,951	16	10¾									

Note.—Those marked thus * are not included in the revenue and expenditure.

No. 358.

Return of Income and Expenditure for the Years 1841–2, 1842–3, 1843–4.

INCOME.

Heads of Income.	1841–2			1842–3			1843–4		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Tonnage, quay, crane and weighing dues	33,493	15	0	31,803	17	8	33,854	2	4
Shed dues . . .	4,419	18	8	4,582	1	9	4,530	4	4
Ferry dues at Broomielaw	1,122	7	6	958	10	6	984	19	4
Sale of Machinery connected with Springfield works.	..			2,408	7	9	2,554	10	8
Received for rhones and planks, used by shipping for removing ashes and supplying ballast .	691	13	4	651	1	5	470	11	1
Watering vessels .	312	8	3	372	0	9	324	3	10
Water pipes across quays	45	0	0	30	0	0	30	0	0
Rent of house at Clyde Bank . .	35	0	0	35	0	0	35	0	0
Cumbray Lighthouse trustees, one year's accumulated surplus. . . .	523	1	7	811	10	4	1,003	14	4
Fines in Water Bailie's Court. . .	35	12	4	52	19	7	57	3	5
rried forward . £.	40,878	16	8	45,709	9	9	43,841	9	4

EXPENDITURE.

Heads of Expenditure.	1841–2			1842–3			1843–4		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Salary of harbour-master, assistants and clerks	529	0	0	545	15	0	529	7	0
Salary of superintendent of police . .	180	0	0	180	0	0	180	0	0
Wages and clothing of officers and watchmen	1,466	3	7	1,581	15	11	1,615	2	6
Proportion of procurator fiscal's salary	40	0	0	40	0	0	40	0	0
Salary to town clerks as assessors in Water Bailie's Court	50	0	0	50	0	0	50	0	0
Law agents, secretaries, &c., their accounts connected with the jury valuations of Springfield, Lancefield, and Finnieston Grounds, &c.	756	13	2	1,283	9	9	1,856	1	0
Witnesses' ditto, and defender's expenses	6,202	0	7	700	0	0	..		
New shed on south quay	2,394	1	8	1,327	15	9	164	18	0
Repairs and furnishings for sheds . .	531	0	2	532	19	4	357	18	5
Causewaying west end of south quay .	1,339	17	5	..			..		
Recausewaying quay west of York-street.	..			769	2	4	..		
Repairing and causewaying south and north quays	2,492	0	0	2,447	15	10	1,039	18	8
Timber for quay walls	..			720	14	7	..		
Dredging harbour and depositing soil at White Inch	6,755	6	7	3,901	12	0	4,232	12	5
Dredging in harbour above Glasgow Bridge.	..			..			2,044	15	11
Printing, stationery, coal, and incidents for police office and court-hall . . .	88	12	10	66	3	10	50	10	8
Cleaning and watering quays. . . .	294	18	0	376	3	6	509	0	5
Rebuilding part of north quay wall, west of York-street	2,342	4	10	..			..		
Rebuilding part and piling quay walls, west of Carrick street	1,350	7	8	..			..		
Lancefield Quay	2,100	0	0	7,100	0	0	4,613	6	5
Purchase of ground at Lancefield . .	5,613	0	0	..			..		
Excavation opposite Lancefield, building wall, and backing new quay . . .	..			..			418	1	5
Purchase of ground at Finnieston . .	..			..			18,773	19	2
Wingate & Co., for ground	..			..			2,514	13	4
Springfield works	21,104	8	2	23,684	18	2	..		
Ditto excavation	..			263	4	0	276	18	5
Ditto, removing stones and building dike	..			..			375	17	3
Ground of Charles Todd's trustees . .	..			13,938	5	11	..		
Ground of Wingate & Co.	..			8,340	16	5	..		
Ground betwixt bridges	..			2,390	19	2	..		
Custom-house quay, piling the quay and foundation, and works connected therewith	..			2,891	0	6	2,412	15	0
Steam-boat wharf, addition and experimental Bude light	..			..			771	4	5
Life-buoys, ladders and hooks . . .	..			..			18	13	6
College for ground in front of brewery-yard	..			..			262	4	11
Compensation for injury to Napier's Dock	..			..			3,000	0	0
Removing stones and piles opposite Napier's Dock	..			..			120	10	7
New weir at Stockwell Bridge on account, and removing old weir from Glasgow Bridge	..			..			1,317	18	3
Fire insurance and repairs on mill . .	253	18	0	..			..		
Gas and oil for quay lamps, and expense of lamps and pipes	404	10	9	398	19	0	359	14	1
Apparatus and expense of supplying shipping with water, including water company's rent	390	13	8	394	5	6	417	7	2
Expenditure on harbour . . . . £.	56,736	17	1	73,919	5	6	51,023	8	11
River.									
Dredging in upper stage of river . . .	1,796	2	1	1,911	6	3	..		
Ditto in lower stage of river	3,158	5	4	4,763	11	3	..		
Ditto in middle and lower stages of river	..			..			3,079	15	5
Mooring posts and forming rendezvous for vessels at bowling	1,361	19	5	..			..		
Quarrying, building and repairing dikes, beacons and quarry mail	1,646	7	0	942	2	8	582	6	0
Preparing stones for rebuilding Govan Ferry Quay	78	9	3	..			..		
Purchase of ground at Pointhouse for widening and straightening river . .	..			2,521	15	5	..		
Expenditure on river . . . . . £.	8,041	3	1	10,138	15	7	3,662	1	5
General Charges.									
Salaries to secretaries, treasurer and clerk, engineer, engineer's assistant and clerks, superintendent and officer calling meetings	1,317	9	0	1,272	10	8	1,274	8	0
Other expenses of collecting dues . .	2,324	10	2	2,570	2	8	2,258	5	3
Wages for repairing and making dredging-machines, punts, boats, &c. . . .	2,348	4	7	1,788	18	0	1,568	0	11
Materials and fittings for dredging-machines, punts, boats, &c.	3,772	12	2	2,434	16	5	1,915	12	4
Carried forward . . . . . £.	0,762	15	11	8,066	7	9	7,036	12	8

Return of Income and Expenditure for the Years 1841–2, 1842–3, 1843–4—*continued.*

INCOME.

Heads of Income.	1841–2			1842–3			1843–4		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Brought forward £.	40,678	16	8	45,709	9	9	43,841	9	4
Total . . . £.	40,678	16	8	45,709	9	9	43,841	9	4

EXPENDITURE.

Heads of Expenditure.	1841–2			1842–3			1843–4		
	£	s.	d	£.	s.	d.	£.	s.	d.
Brought forward . . . . . £.	9,762	15	11	8,066	7	9	7,036	12	6
Expense of 8 iron punts and 24 wooden punts	3,371	17	6	..			..		
Additional machinery for working forward the dredgers by their engines, &c. . .	..			704	13	0	..		
Law expenses in London, Edinburgh, and Glasgow	705	16	9	852	15	7	1,172	18	10
Proportion of expenses in action as to weir at Glasgow Bridge.	..			230	3	10	..		
Secretaries for conveyancing and general business, including stamps, postages, and under clerks	356	13	6	510	11	2	738	4	5
Printing and advertisements	153	18	6	66	19	9	133	3	6
Proportion of expense of survey of river and lighthouses	42	19	7	52	9	0	50	8	6
Survey of Mr. T. Kyle.	..			..			120	0	6
Tack duty of Clyde Bank.	19	13	3	19	13	3	19	13	3
Stationery for tonnage, engineer's and treasurer's offices.	72	8	6	82	0	11	78	6	1
Incidental expenditure and stamps . .	105	14	8	105	16	2	163	18	0
Damage to fishery by operations . . .	215	15	0	195	15	0	195	15	0
Half of price boxes on quay for customs' officers and clerks	30	0	0	..			..		
Subscriptions to public institutions, and annuity to widow Bell	100	0	0	100	0	0	100	0	0
Chart of estuary of Clyde, below Dumbarton, in terms of Act	460	4	6	879	12	6	125	18	6
Soundings of river above Dumbarton Castle	73	1	10	44	6	0	..		
Boring on Greenock Bank	..			37	14	2	..		
Expenses connected with report for best mode of preventing steam-boat accidents	50	0	0	..			..		
Report of engineer as to weir, on remit by Court of Session.	105	0	0	..			..		
Expenditure for general charges . . £.	15,634	19	6	11,948	18	1	9,934	18	1
Ground Annuals.									
Ground-rent of property in Robertson-street	45	0	0	45	0	0	45	0	0
Ground-rent of Windmillcroft . . .	1,600	0	0	1,600	0	0	1,600	0	0
£.	1,645	0	0	1,645	0	0	1,645	0	0
Interest.									
Interest on borrowed money	9,398	4	9	10,508	12	3	11,953	19	3
Grand Total of Expenditure . . . £.	91,456	4	5	108,160	11	5	81,219	7	7

R. Kidston, *Chairman of Finance Committee.*
D Hope, *Sub-Chairman.*
A. Fowler.
W. Brodie.
J. Clark.
R. Shaw.

Debt due on the 1st of January, 1847, 363,800*l*.

No. 359.

Law and Jury Trial Expenses, &c, incurred by the Clyde Trustees, 1836–45.

Year.	Application to Parliament for Bills, &c.			Purchase of Land, Jury Trials, &c.			Parliamentary Opposition.			General Law Business, Contracts, Minutes, &c.			Judicial Proceedings.			TOTAL.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
1836	3,013	10	6	22	16	0	710	13	2	111	19	0	62	4	8	3,921	3	4
1837	3,890	15	8	79	0	7	303	1	4	9	9	10	71	11	1	4,358	18	6
1838	282	7	7	53	12	11	..			316	3	10	113	11	10	765	16	2
1839	720	14	8	512	3	6	13	18	4	6	16	4	58	14	4	1,312	7	2
1840	12,423	18	6	1,738	1	1	..			166	12	3	230	1	6	14,553	13	4
1841	137	3	9	11,405	2	2	365	16	0	401	12	9	121	15	5	12,431	10	1
1842	..			2,052	1	0	373	8	9	366	15	3	149	10	11	2,941	15	11
1843	..			1,683	18	4	924	15	5	753	7	11	260	8	4	3,622	10	0
1844	..			2,850	19	11	51	9	0	721	10	0	172	2	2	3,796	1	1
1845	..			3,087	1	4	5,405	9	8	523	2	2	132	16	0	9,148	9	2
£	20,468	10	8	23,479	16	10*	8,148	11	8	3,377	9	4	1,372	16	3	56,847	4	9

* The trustees are bound by the statute to pay one-half of the expense of jury trials, &c., in all cases, and the expense of both sides, when the jury awards "the same, or a less sum," than that offered by the trustees.

Extracted from the books of the Trustees for improving the River Clyde and Harbour of Glasgow, by

Glasgow, July 18, 1846. Geo. Readman, *Treasurer.*

Appendix C.

Forth and Clyde.

No. 360.

Return of Income & Expenditure.

Forth and Clyde Canal.—No. 360.

Return of the Income and Expenditure of the Forth and Clyde Navigation for the Years 1841-2-3.

INCOME.

Heads of Income.	1841 £	s.	d.	1842 £	s.	d.	1843 £	s.	d.
Canal, &c.—									
Tolls	63,538	12	6	55,438	9	10	49,877	2	11
Sluice, harbour and wharf dues	5,037	0	3	5,308	12	1	4,426	8	8
Timber basin dues	315	13	7	326	16	0	336	11	11
Crane dues	218	15	2	191	1	6	174	14	0
Lamp dues	264	14	5	288	14	4	248	4	8
Passage Boats—									
Passage boat fares	11,214	1	0	7,663	7	4	5,635	19	9
Estate, &c.—									
Ground rents	867	4	7	1,150	0	0	815	16	6
Dock rents	210	0	0	210	0	0	210	0	0
Various buildings' rents	368	0	6	364	0	7	353	14	7
Ferry dike coal wharf rents	45	0	0	45	0	0	45	0	0
Granary rents	141	0	0	141	0	0	141	0	0
Fair dues	88	12	7	92	11	4	92	16	11
Eastermains land rents							189	11	10
Hamilton-hill land and house rent	198	14	0	318	13	7	329	12	9
Miscellaneous—									
Ballast proceeds	67	7	7	97	13	5	14	1	6
Grangemouth gas company	10	0	0	10	0	0	10	0	0
Ice feeder dues	1	1	0						
Fines	19	14	8	8	9	6	59	18	6
Miscellaneous receipts	31	4	10	86	3	10	150	2	0
Old materials sold				203	11	8	179	19	3
Cart boats	78	7	1	638	13	1	485	14	4
Bank boats	19	11	0	150	0	0	6	11	4
Oakbank lighter	..			153	2	3			
Ground sold							16	6	2
Interest account	287	14	7	4,071	10	8	1,484	17	4
Income-tax account	..			.			1,364	13	1
£	90,940	4	7	78,117	5	3	63,510	10	6

EXPENDITURE.

Heads of Expenditure.	1841 £	s.	d.	1842 £	s.	d.	1843 £	s.	d.
Administrative Department—									
Officers' salaries	2,984	11	7	2,887	15	6	2,984	1	11
Lock and bridge-keepers wages	1,580	12	6	1,646	5	10	1,654	9	0
Watchmen's wages	384	14	7	361	2	5	331	0	0
Allowance to retired superintendent	400	0	0	400	0	0	400	0	0
Annual Charges—									
Feu-duties	1,037	4	4	1,245	3	1	1,246	17	7
Timber basin rent	150	0	0	75	0	0			
Taxes							582	10	7
Canal Expenditure—									
General expenses	7,463	14	9	8,439	15	[illegible]	5,785	9	7
Extraordinary expenses	4,402	2	7	1,781	0	1	699	18	10
Contingent expenses	1,465	3	5	1,657	0	0	1,404	6	9
Ice breaking	830	13	10	78	12	3	101	10	0
Lamp lighting and repairs	190	6	8	281	13	4	212	10	2
Repairs—									
Bank boat repairs	283	13	4	115	13	8	85	13	10
Crane repairs	100	8	10	85	17	8	85	13	7
Deepening boat repairs	12	17	6	11	14	[illegible]			
Ferry-dike coal wharf repairs	20	13	2	20	0	0	20	0	0
Iron cart boat repairs	1	14	0	1	17	0	33	15	9
Ice boat repairs	615	3	11	145	4	0	54	10	10
Iron lighter repairs	0	3	6	3	7	11	10	0	1
Passage-boat shed repairs							0	3	0
Passage Boats—									
Cost of navigating	8,184	15	1	6,615	10	7	4,319	18	8
Damages—									
Annual	11	0	0	12	10	0	8	0	0
Adventitious	33	14	3	.			19	19	0
Estate Expenditure—									
Ground improvements, labour and seed	38	19	4	8	5	0	7	10	2
Hamilton-hill land improvements and house repairs	199	5	4	100	2	6	157	6	2
Eastermains lands	317	18	11	71	2	6	76	12	7
Purchases of ground	130	18	0						
Law expenses	370	11	11	290	1	0	51	13	6
Interest account	2,393	1	11	510	7	8			
Income-tax account							1,459	7	10
	33,072	13	9	26,998	2	9	22,305	19	9
Expenditure on improvements	26,142	14	11	58,635	1	4	43,298	8	11
Debt at 31st December	67,500	0	0	65,032	5	6	85,849	18	4

The dues are levied under the authority of the Act 4th and 5th Victoria, cap. 55, and the previous Acts thereon recited and repealed.

Forth and Clyde Canal Office, Glasgow, March 9, 1846.

William Crichton.

Port Dundas.

No. 361.
Return of Income and Expenditure.

PORT DUNDAS.

No. 361.

Return of the Income and Expenditure for the Years 1841-2-3.

INCOME.										EXPENDITURE.			
Heads of Income.	1841			1842			1843			Heads of Expenditure.	1841	1842	1843
	£.	s.	d.	£	s.	d.	£.	s.	d.		£. s. d.	£. s. d.	£. s. d.
Harbour and wharf dues	2300	0	5	1967	10	4	2821	9	7	Expenditure*			
Crane dues . . .	209	14	9	174	19	2	150	5	3				
Lamp dues . . .	108	13	0	94	0	6	103	5	4				
Total . . £	2618	8	2	2236	10	0	3075	0	2				

* The expenditure is so blended with that of the general navigation, that it would be difficult to assign to the harbour its own particular share.

Dues levied under Acts of Parliament.

Wm. Crichton, *Superintendent of Forth and Clyde Navigation.*

Renfrew.

No. 362.
Return to Order of the House of Commons of 9th Aug. 1844.

RENFREW.

No. 362.

Return to Order of the House of Commons of August 9, 1844.

Sir,

Council Chambers, Renfrew, February 12, 1845.

The port or harbour of Renfrew is held by the Magistrates and Town Council of Renfrew as part of the common property of the burgh, in virtue of charters from the crown; the last of which is a Charter of Confirmation and Novodamus by Queen Anne, dated 7th August, and registered and sealed 20th October 1703.

There is no map of the port or harbour in the possession of the magistrates and town council. No complaints have been lodged in their hands of any defects in the said harbour.

George Hutcheson, *Town Clerk.*

Honourable H. Manners Sutton.

No. 363.
Income and Expenditure.

No. 363.

Return of the Income and Expenditure for the Years 1842-3-4.

INCOME.										EXPENDITURE.									
Heads of Income.	1842			1843			1844			Heads of Expenditure.	1842			1843			1844		
	£.	s.	d.	£.	s.	d	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Tonnage dues at 2*d.* per ton . . .	63	10	7	47	5	7½	60	0	0	Harbour-master's salary	1	1	0	1	1	0	1	1	0
										Collecting dues . .	5	18	10½	4	14	6	6	0	0
										Repairs	53	15	0		..			..	
											60	14	10½	5	15	6	7	1	0

Dues levied under authority of Royal Charter.

R. M'William, *Treasurer.*

Port Glasgow.

No. 364.
Return to Order of the House of Commons of 9th Aug. 1844.

PORT GLASGOW.

No. 364.

Return to Order of the House of Commons of August 9, 1844.

Glasgow, April 17, 1845.

I. Titles of Statutes under which the Trustees have acted and do act.

1st. An Act passed in the 12th year of the reign of King George III., cap. 16, intituled "An Act for deepening, cleansing, scouring, preserving, and maintaining the Harbour of Port Glasgow; for enlarging and improving the Quays and Piers; for erecting new Breasts, Jetties, and Piers; and for regulating Ships, Lighters, and other Vessels, trading into and going out of the said Harbour; and for other purposes therein mentioned."

2nd. An Act passed in the 41st year of King George III., cap 52, intituled "An Act for explaining, altering, and amending an Act made in the 12th year of the reign of his present Majesty, for deepening, cleansing, scouring, preserving, and maintaining the Harbour of Port Glasgow; and for other purposes mentioned in the said Act."

3rd. An Act passed in the 11th year of King George IV., intituled "An Act for improving the Harbour of Port Glasgow, constructing a Wet Dock or Wet Docks adjacent thereto; and for altering the Road leading from Port Glasgow to Glasgow, near the said Harbour."

II. Plan of Harbour and Docks.

III. Reports, by Engineers, of which copies are sent.

1st. Copy report by James Walker, Esq., civil engineer, London, 1830.
2nd. Report by Charles Atherton, Esq., civil engineer.
3rd. Report by David Logan, Esq., 1837.

IV. Complaints made as to defects of Harbour.

None. The walls of the wet dock, however, constructed under Mr. Atherton's plan, partially gave way, and the Trustees were put to considerable extra expense on this account.

A. Turner,
Secretary to the Port Glasgow Harbour Trustees.

Honourable H. Manners Sutton.

No. 365.

Report by JAMES WALKER, Esq., C.E., F.R.S., *on the best means of obtaining additional Accommodation.*

No. 365.
Walker, on obtaining greater Berthage.

Glasgow, Nov. 18, 1830.

IN my Report to William Hamilton, Esq., dated 8th July, 1828, I stated the general advantages of a floating dock at Port Glasgow for the trade of the Clyde, with the expense, and a general description of the dock as then proposed. An Act for the forming of the dock has since been obtained, and the interval has enabled me to make some observations and to hear some remarks, which I think it my duty to state to you.

As a proof of the general increase of docks, I may mention that since my former Report was written considerable progress has been made with a large dock at Aberdeen; that an Act is to be applied for during the present session of Parliament for making docks and other improvements, to the amount of 300,000*l*., at Belfast; and that the trade of Dundee has increased so much within the last six years, when the dock was finished, that an extension of dock-room is already required, and an Act for such extension was obtained last session. Consequent improvement of the property is natural, and I am informed very apparent.

The expediency of additional accommodation at Port Glasgow for heavy ships will be more evident when the present limited accommodation is considered. There are at present berths in Port Glasgow harbour for only eight laden ships, six of these berths having 16 feet, and two having 18 feet, at high-water of spring-tides, and 3 feet less at neap-tides. There are therefore now constant complaints owing to the want of room, and the detention from want of water during neap-tides. This is injurious at all times, but more particularly in time of war, when ships must be ready to join convoy. The vessels belonging to Port Glasgow are full-built to take the ground without damage; but this is injurious to their fast sailing, and is therefore more objectionable during war; while sharp-built ships of other ports and countries avoid going where they are to lie aground. The expediency, and almost necessity, of a wet dock in the Clyde thus becomes every year more apparent; and the state of repair of the east and middle quays of the present harbour is said to be such as to require a large expenditure for repairs, unless additional accommodation be provided.

Since my plan was made some alterations have been proposed which it is my duty to state. The first is in the depth of the lock, which I proposed to have 20 feet at the high-water of spring tides and 17 feet at that of neap tides. It has been proposed to add 3 feet to this, making 23 feet in spring tides and 20 feet in neap tides, so that vessels drawing 20 feet may enter and go out at all times. For the same reason it has been proposed to deepen the dock; but it appears to me unnecessary to carry this increase over the whole surface. My idea therefore is to give the additional depth to a few berths on the north side. These alterations may add about 3000*l*. to the estimate.

The propriety of adding to the width of the entrance-lock, so as to make it capable of receiving the largest steam-vessels, was discussed; but, on comparing the advantages with the expense, has been thought inexpedient. The lock was proposed to be 38 feet wide; an addition of 7 feet would be necessary for the largest steamer.

The most important alteration of all that have been proposed is the extension of the river-wall to deep water, and sinking the wall so low that ships of heavy burthen may approach and leave at all times of all tides. The river-line, as before proposed, and that now suggested, are both shown upon the accompanying plan. I have no hesitation in saying that the alteration here proposed would form a most important improvement, and would, to say the least, make the accommodation inferior to none in the kingdom. Indeed I am not aware of a dock anywhere possessing such an advantage. Its utility to the trade of the Clyde would be very great indeed, and it would be taking the full advantage of the natural depth of the river, by which a ship drawing 18 to 20 feet of water would come up and moor alongside the quay at low-water, or leave the quay after coming out of the dock in the same manner at all times of the tide.

The first expense of doing the work prevented me from originally forming the plan in this manner. I proposed carrying the line of the river-wall a little beyond low-water, and down only to that level, with sheet-piling in front. This I am ready to admit to be very inferior to the deeper and more extended plan, and not to be defended, except on the score of expense, and I may add, first expense; for the space which will be formed between the dock and the river will be sufficient not only for a quay in front of the river, and another quay in front of the dock, but also for sites of warehouses, which from their peculiar situation must be very valuable, and should go a great way to compensate for the additional expenses. I may also remark that the great head of expense is the foundation of a dam to enclose the whole bay, and that by means of it every part of the inner works will be done in the dry, which is always an important consideration with contractors.

Detailed plans will be required to enable me to estimate the addition to the cost that will be caused by the wall as above proposed; or if plans and a specification, with tenders from contractors, be preferred to an estimate, they shall be prepared without delay on my return to London.

J. WALKER.

No. 366.

Report by CHARLES ATHERTON, Esq., C.E., *on the best Means of constructing the proposed Docks.*

No. 366.
Atherton, on constructing proposed Docks.

March 22, 1833.

THE Committee having been authorized to proceed with the Port Glasgow harbour improvements, on the principles of the plan prepared and signed by me, and dated at Glasgow, 21st February 1833, but with power to conduct the works in such manner and make such corrections as they may from time to time deem advisable—which plan, having been duly considered by the Committee, and matured, after much investigation and discussion, was submitted to the General Meeting of the Trustees, and approved by them, as the principle or outline of works, on which a limited sum was authorized to be expended, the practical details being left under the control of the Committee of Management, as before mentioned; it now remains for me to report to the Committee as to what arrangements ought, in my opinion, to be adopted for putting the proposed works in immediate working train. The present stage of this business has, for a long time past, been looked forward to by myself; and, knowing its vital importance, I am particularly anxious as to the decision of the Committee upon it. Without further preface, I may come at once to the main question—whether the whole of the works should be let under contract, or whether it will not be more satisfactory to make

No. 366.
Atherton, on constructing proposed Docks.

a distinct arrangement for that portion of the works below low-water than contracting subsequently for the works above low-water. I am of opinion that the Trustees will best serve their own interests by making express arrangements for the execution of that portion of the work *below* low water, and entering into contracts for the superstruction *above* low-water, after the foundation shall have been made up to that level. The Committee must, at once, see the difficulties under which an engineer is placed in conferring on this subject, if their decision be made to depend solely on the force of argumentative discussion; because this is one of the many subjects of which nothing but absolute experience can duly teach the practical bearings. I, therefore, do not condescend upon the detail of the basis of my opinion, but merely beg to inform the Committee that, during the execution of the St. Catherine Dock works in London, I was in the service of the contractor, engaged in the practical department of the work, much of which was of a similar description to the work now to be performed; and I presume that, on this score, my opinion will have more weight than if I had been constantly engaged in one interest only. I also beg to submit, for the especial consideration of the Committee, an instance which will, I am sure, have much influence on their decision:—That the River Clyde Trustees, after having contracted for and built several hundred feet of quay-wall during the last summer, experienced such difficulty relative to the foundations (although the contractor acted, in my opinion, honourably, and did everything that could be fairly demanded of him) as induced the Trustees to give the contractor a premium to resign his contract for the foundation-works; and at the present time the River Clyde Trustees are executing the foundation-work of the Broomielaw quays under the direction of their own officers. I therefore beg to recommend to the Committee on Port Glasgow Harbour the adoption of the following measures:—1st. That some person who has had many years' experience of tide-works, and is perfectly acquainted with temporary coffer-damming and the working of crab piling-engines, and is competent to take charge of measurements and understands engineering drawings, be appointed as manager of works. 2nd. That the whole of the works below low-water be executed under the constant superintendence of this manager. 3rd. That, since nearly the whole of the works below low-water consist of piling, the manager shall contract for the labour of working the engines with the different gangs of men at each engine, paying the men a price per cubic foot for the quantity of timber driven by each gang; and that no more men shall be kept on days' wages than is absolutely necessary to erect the stages and perform the necessary jobbing about the work. 4th. That orders be given to Mr. Atherton to procure six piling-engines, in working order complete, of the same construction as those now in use at the Broomielaw Harbour, provided that he can procure them, to be delivered at Port Glasgow, previous to the 10th day of April, at or under the price of 22*l*. 10*s* per engine. 5th. That orders be given to Mr. Atherton to procure tenders for Scotch fir piles, and 2000 feet of Quebec red pine; which tenders are to be submitted to the Committee at their next meeting, and such other materials as he may think necessary for putting the works in immediate progress. 6. That, during the progress of these preparatory measures, Mr. Atherton be required to prepare the drawings, in a proper working scale, and full written instructions, for the direction of the manager of works. 7th. That Mr. Atherton and the Chairman of the Committee be authorized to consult together, and insert in the public papers such advertisements as the Chairman may deem necessary for the furtherance of the objects above stated, and for bringing forward contractors for the masonry and other works above low-water, to be hereafter contracted for, agreeably to the specifications which will be prepared by Mr. Atherton and submitted to the Committee in due time, whilst the foundation-works are in progress. I have only farther to express my opinion, that by adopting these measures the works will be fairly started within one month, but that by preferring any other course the present season will pass without any effectual work being performed.

I am, &c.,
CHARLES ATHERTON.

No. 367.

Report by DAVID LOGAN, Esq., C.E., *on deepening the Wet-dock, and affording better Accommodation to Shipping.*

No. 367.
Logan, on improving the Dock and Harbour.

GENTLEMEN,

Glasgow, May 16, 1837.

YOUR Chairman, Provost Falconer, some time ago communicated to me your wish to ascertain, as soon as possible—1st, The most effectual and suitable method, in the present condition of the wet-dock, to make it available for the accommodation of the largest class of vessels frequenting the port; 2ndly, The best situation and construction of a shed for the protection of goods, as also the proper number and position of cranes required for the use of the dock; 3rdly, The practicability of affording berthage to vessels on the outer line of the docks, from the entrance-lock of the wet-dock westward, and the best plan to accomplish this; 4thly, The estimates of the expense required for the above undertakings.

To enable me to make up my mind on these matters it was necessary to take a number of transverse sections of the wet dock and its walls, of the rubble embankment, and the channel of the river outside the dock. When I had finished my drawings of these, the embankment subsided and extended its base to a considerable breadth, becoming thereby more consolidated and affording a foundation much more suitable for future operations. But, from the material change on it, I was obliged, before reporting, to take the transverse sections anew. This and other preliminary inquiries being accomplished, I beg to transmit my plans, and this report, explanatory thereof, as the result of a very deliberate investigation of the matters submitted to me. An estimate of expense is also subjoined. About 120 feet of the inner wharf-wall, from the entrance lock westward (the extremities of this line are marked A and B on the plan), are on a sufficient foundation, and will admit of the soil close to its front being removed to the depth required for a berth to one of the largest class of vessels. But the remaining portion of this line, and the whole of the west wall, being raised on piles driven on soft alluvial, requires all the soil at present in front of it for its support. To remove that soil to the depth required for allowing vessels of large burden to lie close to the wall would most seriously endanger its stability. This therefore cannot be done at present; but the end in view may be obtained by erecting two wooden platforms on the west line of the wet-dock wall, each to be at least 40 feet long, and to project into the dock 30 or 35 feet, to be supported upon substantial piling and well framed with diagonal beams and braces. A third platform, of like construction and dimensions, to be placed in front of the warehouse on the south side of the dock. I would further recommend that the piles on which the said platforms are erected be cased with 4-inch planking from the bottom of the

APPENDIX C.

PORT GLASGOW.

No 267.
Logan, on improving the Dock and Harbour.

dock up to low-water mark of ordinary tides. The space between the planking and the front of the wharf wall to be completely filled up with small stone, the weight of which will be an effectual support to the wall in front, and enable it to bear the pressure of the made-up ground behind. This being finished, the soil may be removed by the dredging-machine in front of the platform, so as to enable vessels of the largest size, loaded or unloaded, to be continually afloat. As the made-up ground has not subsided most probably as far as it will, and consequently has not yet attained its utmost degree of consolidation, it would not be advisable to erect any permanent shed. A light wooden erection may be sufficient. I have marked on the plan a site for one. The platforms above described should be each provided with a crane, to be of sufficient power for the convenient management of heavy goods. I have marked on the plan the proper position for these. I can see no better plan of proceeding in respect to the outer side of the dock wall than to persevere in throwing in more rubble, in order to raise the embankment to the height from which it has lately subsided. The space between this embankment and the back of the wet-dock wall will be, as formerly, a proper place to deposit the stuff dredged from the dock. A portion of hard rubbish, smithy ashes, and the like, with a quantity of brushwood to assist in binding these, should be put in among the layers of mud. Care should be taken to cause these materials to settle down or cake most closely, and if possible each layer should be allowed a certain time to dry and consolidate. I would advise that no time be lost in taking up all the piles driven by Messrs. J. Gibb and Son for a foundation to the wall that gave way, as their present state is most dangerous to the shipping, and the timber may prove useful in some of the projected operations. Before concluding this report, I take the liberty of stating that the outer embankment may still, from time to time, sink a little. This should not be viewed as of any importance; each sinking of it will become less and less; a steady perseverance in adding more stuff will soon get the better of any subsidence that may now be expected, and a consolidation to be depended upon will be very speedily obtained. The accompanying plan of the wet dock, with the transverse sections, and the plan, elevation, &c., of the wooden platform, Nos. 1, 2, and 3, will assist in making the suggestions in my report more fully and clearly understood.

I have, &c.,
DAVID LOGAN.

Estimate of the Expense for completing the several Works as suggested in the foregoing Report.

To three wooden platforms for wharfage	£ 1000
To three cranes for ditto	250
To a shed for the protection of goods	200
To making up the rubble slope	500
To dredging in the dock and embanking the ground . .	400
	£ 2350

The Harbour Trustees, Port Glasgow.

DAVID LOGAN.

No. 368.
Income and Expenditure.

No. 368.

Return of Income and Expenditure for the Years 1841–2–3.

INCOME.										EXPENDITURE.									
Heads of Income.	1841			1842			1843			Heads of Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Harbour dues .	1873	2	6	984	19	9	1433	0	5	Salaries, &c. . .	165	1	10	130	9	3	165	6	9
Shed and crane dues . . .	322	14	9	111	0	3	106	9	2	Maintenance of harbour & dock	812	15	6	454	6	0	438	10	11
Sale of ballast .	35	13	10	19	13	8	18	2	4										
Rent	100	0	0	100	0	0	95	7	8	Advertising and general charges	2	16	8	2	7	11	1	0	0
										Interest . . .	1687	10	5	1647	10	10	1656	17	4
Total . £	2331	11	1	1215	13	8	1652	19	7	Total . £	2668	4	5	2234	14	0	2251	15	0

Dues levied under Act passed 1830.

MICH. MATHERS, *Pro Treasurer.*

Debt due on the 1st of January, 1847, 36,582*l.*

No. 369.

Answers to printed Queries from Port Glasg

PORT Glasgow lies on the south side of the Clyde, at 18½ miles below Glasgow Bridge, and has good anchorage off it in 18 feet at low-water, and 28 feet at high-water spring tides. It has two artificial tidal harbours of 3½ acres each, and one wet dock of 10 acres in extent. Entrance of harbours is 130 feet wide, and faces the north-east; the entrance of wet dock is 53 feet wide, and faces east, and is entered by a lock having 14 feet depth on the sill at low water. Depth outside, at entrance of harbours and locks, 10 feet. Spring tides rise 10 feet, neaps to 8 feet; extreme tides, 15 feet, measured by a self-registering tide gauge, the invention of Mr. John Wood. There are 3 building-yards, employing about 150 shipwrights; one graving-dock, 70 feet wide; width of gates, 32½ feet. Two quay cranes for 2½ tons each. Extent of wharfage, 4,720 feet available, 1,570 feet not yet built. The quays are built of freestone, and neither they nor timber piles are bored by any worms. A deposit of about 12 inches annually takes place, which is kept free by a steam-dredge of 20-horse power, which raises about 200 tons a-day, at an expense of 2½*d.* for dredging, and 1½*d.* per ton for depositing, or the whole under 4*d.* a-ton. Supplies of provisions, naval stores, and coal, abundant, and water led down to the quays. The tonnage belonging to the port, including steamers, 13,009.

*

APPENDIX C.

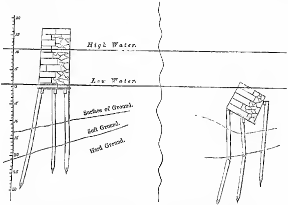
GLASGOW.

No. 369.
Answers to Queries printed.

Foreign arrivals, 91 ships of 41,670 tons, with 1,770 men; departures, 79 ships of 39,694 tons, with 1,740 men. Coasting arrivals and sailings, 374 vessels, of 10,000 tons; regular traders, 74; casual, 300 vessels. The population is about 7,500, and the seafaring portion 450. The best charts and plans must be the Admiralty Surveys recently made by Captain Robinson, Lieutenant Bedford, and the officers of the "Shearwater," and it is very desirable that they should be published as early as possible, for the benefit of navigators.

The harbours by Act of Parliament, 17th June, 1830, which names as trustees the corporation of Glasgow, 50 in number, together with 6 members of Port Glasgow Town Council, and 5 merchants, 3 of whom reside in Glasgow. There is a harbour-master, but no resident engineer. The pilots act under a joint Glasgow and Greenock Pilot Board, and are considered sufficient. The harbour trust maintains 1 light on the pier, with 7 burners; 1 red fixed light at harbour entrance, and 1 shore light a mile east of harbour; gas is burned in the two former, oil in the latter. Annual cost, 50*l*. The revenue in 1846 was 2,505*l*.; debt on 2nd February, 1847, was 36,582*l*., of which 13,000*l*. is preferable, and bears 5 per cent. interest; postponed, 23,582*l*., of which last item the corporation of Glasgow is creditor to the extent of 10,000*l*., the remaining 13,582*l*. being due to parties in Port Glasgow. Total amount empowered to raise, 74,464*l*. About 450*l*. are expended annually on repairs, but nothing has been laid out in improvements for many years.

The country around Port Glasgow is said to abound in minerals; there is a freestone quarry half a mile distant, from which blocks of 5 tons may be procured. The military defences of the harbours are *nil*. The works that are wanted for the benefit of navigation generally are the removal of the perch opposite the harbour, and thereby to enlarge and improve the anchorage and navigable channel of the river; and for the improvement of the harbours, to build a large graving dock to accommodate the ships frequenting the port, many of which are forced to go to Greenock; and to complete the wet dock, by repairing the gates and walls.



Port Glasgow quay wall as built in 1831. Quay wall as it fell in 1832.

ATHERTON, *Engineer*.—GIBB, *Contractor*.

APPENDIX C.

GREENOCK.

No. 354.
Evidence taken on
the 20th Oct., 1846.

GREENOCK.

No. 370.

Examining Commissioner:—Captain WASHINGTON, R.N., F.R.S.

Present: Provost FAIRRIE, Walter BAINE, Esq., M.P., J. TASKER, Esq., — ANDERSON, Esq., T. HAMLIN, Esq., J. K. GRAY, Esq., Town Clerk; J. MARTIN, Esq., Chamberlain; T. O. HUNTER, Esq., Agent for Lloyd's; Captain SHANNON, Captain M'INTYRE, Captain J. ALLEN, Harbour Master; — BLAIR, Esq., J. B. CUMMING, Esq., Lloyd's Surveyor; Mr. W. ALISON, John MILLEN, Pilot, and several other pilots and sailors.

Provost FAIRRIE, in introducing the Commissioner to the meeting, which had been called by public advertisement at his request, said that an opportunity would be afforded for any having complaints to make, and for those who could furnish information that might be of use, to do so. He might mention that he was glad of the opportunity thus furnished to refute a passage in a report of the Commissioners of the Tidal Harbours, in which it was said that there had been an improper expenditure of money,—that, in fact, the money expended in improving the lower ports on the Clyde had been thrown away. He had no doubt they would be able to remove that impression, and show that it was at best but very questionable whether, if less money had been expended on the river and more on the improvement of the lower ports, it might not have been more to the advantage of all parties. The Clerk to the Trust would exhibit and explain the minutes, and the Treasurer would show the state of the accounts of the Trust. Evidence would also be given of the capabilities of the port—as to the insufficiency of the present harbours for the trade—and as to the means adopted and now in progress for the increase of their accommodation, especially for vessels of a very large size.

The COMMISSIONER then read and laid on the table her Majesty's Commission, empowering the members to take evidence on all matters referring to harbours, &c., and on oath, if thought necessary. He then stated that his purpose in coming to Greenock was to inquire into the past and present condition of the harbours there, as well as into their future capabilities. They were aware that in the progress of railways easy access was constantly sought to the deep water, and their operations rendered it necessary to have perfect knowledge of the state of the harbours. The references to Greenock in the report alluded to by the Provost were only meant to illustrate the necessity of enquiry and controul. No opinion could have been given without hearing what might be said here, and his appearance that day and the inquiries he should make, would, he was confident, disprove any slight being intended to Greenock.

The PROVOST, in case it might be thought he had exaggerated matters, would read the paragraph referred to :—

"That weirs have been permitted across the river, nay, sanctioned by Act of Parliament, so as to prevent the flow of the tide above the city, and stop all navigation above the bridges; that a considerable expense for dredging might have been saved if the natural flow of the tidal water had been properly directed; that the harbour space might have been enlarged, and the general depth of water throughout the river increased: and that with all these improvements the dues on shipping might have been lightened, and the ports of Greenock and Port-Glasgow at the mouth of the Clyde might have been spared a large expenditure in the construction of docks made in expectation of traffic which it is not probable will ever now be realized."

COMMISSIONER.—Then, Mr. Provost, let it be our business this day to disprove anything that may appear wrong in that statement.

John Kerr GRAY, Esq., Town Clerk, examined :—Had been upwards of twenty years connected with the Harbour Trust; his duty was to attend and take minutes of meetings of that body—to advise the Magistrates and other Trustees, and to transact all the legal business of the Trust. He produced the minute books of the Trust, and also the minute books of the committees, which were examined by Captain Washington. He then produced the different Acts of Parliament, regarding the town and harbours, and stated that the first Act of Parliament relating to the harbours of Greenock was the private statute of the 24th Geo. II., obtained by the superior of the town, and the inhabitants thereof, for levying a local duty on ale and beer, for completing, among other undertakings, the harbour which had been begun to be erected by voluntary subscription about the year 1705. The persons by whom the duty was administered were called Trustees, and were named in the statute referred to. The next Act of Parliament was the 13 Geo. III., cap. 28, which vested the harbour in the Baillies and Town Council, and their successors in office. The Baillies and Council were, by a charter from the superior of the town, annually appointed by the feuars or proprietors of houses in the burgh, until the passing of the Burgh Reform Bill in the year 1833. Certain commissioners were by the statute 13 Geo. III. appointed to co-operate with the Trustees. By subsequent statutes the number of Trustees was increased. In virtue of the Act 13 Geo. III., power was given to borrow 5,000*l.* Several clauses of this Act have been repealed by subsequent Acts; further powers were asked from and sanctioned by Parliament, particularly the Act 5 Vict. cap. 54; power was obtained to borrow 220,000*l.* Under authority of this Act the new harbour, designed by Joseph Locke, Esq., now being constructed at the east end of the town, was contracted for, the contractors' estimate for which is 90,000*l.* There is also a retaining wall now in the course of erection to the westward of the present harbours, the expense of which will be 11,000*l.*, and which will extend to about 150 feet beyond low-water mark. The sanction of the Admiralty for these works was applied for by Mr. Locke, and had been obtained. The plans were now in the hands of the Admiralty.

The COMMISSIONER recommended that they should be applied for.

Mr. GRAY.—The bye-laws authorized by the Acts had been carried out. The dues on vessels were considerably below what they were authorized to charge. The Magistrates were authorized to license pilots. The Harbour Trust, by the recent Acts, consisted of sixteen members, chosen by the Parliamentary electors as Councillors, and who, as such, are Harbour Trustees. The only qualification required is being on the roll of Parliamentary electors. Previous to the passing of the Reform Act, there was a large constituency, consisting of the whole of the feuars, a very numerous body. There are

APPENDIX C.

GREENOCK.

No. 370.
Evidence taken on the 20th Oct., 1846.

always shipowners, and frequently retired shipmasters among the members of Council. The Trustees are also Commissioners on the harbours, along with nine gentlemen paying at least 12*l.* a year each of harbour dues, elected by owners and part owners of ships trading to the port, paying at least 3*l.* per annum of harbour dues. The Commissioners sanction new works authorized by Trustees, and audit their accounts. But the Commissioners seldom attend the auditing of accounts. Is not aware what would be the effect of the Commissioners' refusal to sanction works; but if they do not attend the yearly diets for examining and certifying accounts, a quorum of the Trustees may, by the Act 50 Geo. III., docquet the books and accounts of the Trust. The Act 13 Geo. III. authorizes a certain number of Glasgow Commissioners to be appointed; but for twenty years none have attended.

The PROVOST remarked that there were eight Glasgow and nine Greenock Commissioners, elected by shipowners, all gentlemen paying dues at Greenock. No practical inconvenience had ever arisen from the existing law.

Mr. GRAY continued—Numerous representations were made by shipowners of the want of sufficient accommodation. These assumed the form latterly of a memorial, which is engrossed in the minutes. The subject of further accommodation was remitted to the Harbour Accommodation Committee, and was very frequently discussed by them, and they reported to the Trust in favour of improvement. The subject was repeatedly before the Trustees, and ultimately it was unanimously agreed to construct an additional harbour, and the other works now in progress. Some discussion took place in the town some years ago regarding a breakwater on the bank opposite Greenock; and is referred to in the Report by the Harbour Committee. Powers were taken in the last Act to construct a breakwater, subject to the approval of the Admiralty, which approval has since been given. No complaints have ever been made regarding the management by the Trustees of the harbours; if so, they would have been entered in the minutes. Eight members of the Trust form a quorum, and they meet once a month, regularly—more frequently if business arise. It was his duty to attend all meetings of Trustees and of Committees, and keep their minutes. He handed in his note and minute-books and letter-book, in which all letters are preserved.

The COMMISSIONER said, so far as he could judge, on a cursory inspection, he found the books well and carefully kept.

Captain Archibald SHANNON examined—Has been Collector of Harbour-dues at Greenock for ten years, and has been acquainted with the port from his youth. There was a progressive increase in the receipts of dues up till 1842, when there was a very severe depression, which continued till 1844; since then there has been again a gradual increase. In 1843 there was also a large reduction in the rate of dues. He was not at the moment prepared to state the amount of receipts of dues for years back, although he had such returns.

Walter BAINE, Esq. said it might be convenient for him at this place to read notes which he had prepared of the receipts of harbour dues.

	£.	s.	d.		£.	s.	d.
In 1830 these amounted to	11,140	16	7	In 1840 these amounted to	15,737	13	8
1835 ,,	13,807	19	8	1841 ,,	16,759	18	5

In the years 1842-44 there was a very great general depression of trade, and a consequent falling off in the amount of dues. As had been mentioned, there was also a large reduction made in the rate of dues.

	£.	s	d.		£.	s.	d.
In 1842 these amounted to	14,044	0	0	In 1845 these amounted to	14,564	0	0
1843 ,,	12,661	0	0	1846 ,,	14,320	0	0
1844 ,,	11,526	0	0				

Captain SHANNON continued—The deduction was as much as twenty per cent. on vessels engaged in foreign trade, and made in all a difference of 2000*l.* a year, being an advantage to that amount to the shipping and to merchants. Before he was appointed collector of dues he had been harbour master of the port, and had frequently heard complaints of the accommodation for ships being insufficient for the trade of the port. Complaints were also made of the kind of accommodation—that the vessels were not kept afloat, or at least nearly water-borne. Is aware that for this reason vessels have gone to Glasgow which would have remained here, although there is no better accommodation there. Has heard shipmasters say they would pay a higher rate were their ships water-borne. Has been at sea since 1802; is decidedly of opinion that a harbour master should be a practical sailor; is aware that large additional accommodation is now in progress at Greenock for ships of large burden, where they will be kept entirely or very nearly water-borne. The bottom of the harbour is in general soft clay, and there is not the slightest danger of vessels being injured by lying; long ships lie without damage, as they can do so on even ground. Many timber laden vessels come to the port; and this trade is of such importance as to require further accommodation. A wet dock would be a great hindrance to the timber trade; the vessels in this trade are from 400 to 1100 and 1200 tons. From the small rise of tide at Greenock, it is not fitted for wet docks. The port of Greenock is very easily approached from sea; there is no difficulty whatever, and pilots are not required in general. Pilots are sufficiently numerous; were they fewer in number, there would be employment for them. The taking of pilots is not compulsory; thinks it should be so, as in London, Liverpool, &c.; but would not apply this to regular trading steamers to Dublin, Liverpool, &c. The water in roadstead is from 24 to 12 feet at neap tides. There is ample water for the largest vessels frequenting the port, at all times of the tide, to anchor in the roads. There are screw-anchors (Mitchell's patent screw moorings) in the roadstead for vessels to lie at—vessels frequently lie in the roads in severe gales in perfect safety. The Greenock bank forms at low water a breakwater against the north-east wind, the only one that blows into the harbour. As the vessels now lie in perfect security inside the harbour, does not think the formation of a breakwater on the bank worth the expense it would cost, as the money could be much better employed in other works. The accommodation proposed to be afforded by the new harbours will be 6¼ acres. It is much and immediately needed—ships are at present not sufficiently or promptly enough attended to in regard to berthing. The new harbour will be sufficient at present without wet docks. The width of entrance of the new harbour is to be 150 feet, which he thinks a good width. There is little deposit in the harbour by the river; it is very easily removed by dredging. In the new harbours there will be nearly 14 feet of water at low tide, and this depth will be maintained at little expense. There is a dredging machine belonging to the Harbour Trust. Is aware of a pier being about to be erected by the Railway Company to the eastward of the harbours. It will not interfere with the current of the

APPENDIX C.

GREENOCK.

No. 370.
Evidence taken on the 20th Oct., 1846.

river if kept within the line of the present harbours. The current keeps close along the face of the harbour; the latter part of the ebb flowing into the mouth, but does not bring much deposit. By the erection of a small wooden wharf beyond the east harbour vessels are kept nearly afloat at all times. Captain Shannon here read and handed in a return of vessels and tonnage for the year ending 5th January, 1846:—

		Ships.	Tonnage.
Vessels from foreign ports, entered	inwards	316	112,488
Do.	outwards	280	111,476
Do. Coasting	inwards	468	69,385
Do.	outwards	449	77,482
Total		1513	370,831

—These are only vessels that enter and clear at the Custom-house, not including steamers carrying passengers, or ships entering and departing coastwise in ballast; were these added, the numbers would be doubled. Steamers, such as those to and from Liverpool, taking in or discharging part of cargo in passing, and not clearing at the Custom-house, are not included in the above return. In reply to questions, Captain Shannon repeated what he had said regarding the want of, and demand for, additional harbour accommodation. When the new harbours were completed, all ordinary sized vessels would be almost entirely water-borne at all times. Timber-laden ships will be much better accommodated in the tidal harbour than they would be in a wet dock. It was proposed, he understood, to appropriate the berths at the mouth of the new harbours to large deep-sea steamers, which had to sail hence at hours to suit the tides at, and the departure of trains from, Liverpool, Belfast, &c.; for this class of steamers a wet dock was unsuited, as only at particular times of the tide could they get in or out. Taking into account all the wants and requirements of shipping, the proposed tidal harbour was much better suited for this port than a wet dock. If the works be carried out as proposed, he was satisfied it would be the best for steamers, and for the discharge of timber from large ships. Many large steamers were built and fitted up with their machinery at this port, some of them, such as the West India fleet, drawing with their machinery on board 12 feet. In the new harbour this may be done, and the vessel afloat the whole time. He was satisfied that the improvements now going on were the very best that could be had for the circumstances and requirements of the port. Railways were constantly progressing towards deep water; in proof of this he referred to the recent purchase by a railway company of the Ardrossan Harbour. The Caledonian Company had also purchased the Greenock line with the same view. He looked with confidence to a very great increase of the trade of this port when the Greenock railway would be connected with the lines to the eastward of Glasgow, in the export of minerals of all kinds, especially iron and coal, and indeed of traffic of all kinds. Vessels never break from their moorings in the Greenock harbours; the easterly gales are most felt in the harbours; but no damage is ever done if vessels are properly moored. Greenock is well supplied with graving docks, of which there are four—two public and two private; there were two patent slips, which were removed by the progress of the new harbours, and only one has yet been replaced; there are eight or nine building slips, besides those for large iron steamers. There are four large iron steamers now being built, two by Messrs. Caird & Co., one of 1400 tons, and another smaller, for the Oriental and Peninsular Steam Navigation Company; one, by the same builders, for the Liverpool trade, and the frigate of about 1700 or 1800 tons for Government by Messrs. John Scott and Sons. The whole of the steamers for the Halifax line have been built here of wood, and their machinery built and put in at Glasgow by Mr. Napier; six of the Royal Mail (the West India) steamers were contracted for and had their machinery erected here, four by Messrs. Caird & Co., and two by Messrs. Scott, Sinclair & Co.; five of them being also built, and the whole of them equipped here. There is a very large crane at the East Harbour for putting machinery into vessels: it has been proved to fifty or sixty tons, and is the most powerful in Britain. There is the greatest facility of access from sea to the river and port. Vessels are more likely to have quick despatch from the lower ports than from Glasgow, as in the event of change of wind, a few days' detention may make a great difference on the length of passage. A ship loaded to 15 feet going at six miles an hour would reach Port-Glasgow bank in three hours. Owners do not like their vessels scraping along the ground coming from Glasgow. The depths outside the harbours here at low water are from 6 to 10, 11, and 12 feet. The harbours must not be dredged further; the quays are built on cassoons and piles, and every thing has been done to increase the depth of water that can be done with safety. It would not be judicious to expend much money on erecting wooden quays here outside of harbours, as has been done at Dublin, Liverpool, &c., unless the piles were copper sheathed, as there is a worm that attacks timber very badly. [In answer to Mr. Allison, Captain Shannon said] The best wind for leaving Greenock for sea is easterly; this wind, which is the most prevalent at some periods of the year, lessens the water in the river as much as five feet; and a vessel lying at the Broomielaw loaded ready for sea drawing from 15 to 16 feet, would have to wait for a change of wind to bring up water enough to take her down. Has known a vessel coming down lie in the river nine days, dragged at each tide along the ground from place to place; and they have occasionally to lie as long here for water to take them up: knew a case where a vessel coming down took the ground suddenly, and by the power of the steamer dragging her, had the windlass taken out of her. [In answer to Mr. Blair, Captain Shannon said] Thinks the bank is rather increasing towards the east; is shelving more, although it is impossible injury can be done to the harbours by its approaching where there is such a current; the deposit is caused by the dredging going on above, and can be easily kept clear. Thinks that vessels take the ground now more frequently than they did thirty or forty years ago. [In answer to the Provost, Captain Shannon said] The largest vessels thirty years ago frequenting the harbour were 420 tons; the largest now are 1200 tons; this should certainly account for their more easily grounding; much that was said about the increase of the bank is mere fancy, as people have no data to judge by; it is only within a few years that proper plans have been made, and correct soundings taken; those formerly used were made in far too general a way. [Mr. Todd asked if Captain Shannon did not think that the improvements now going on would have been better to the westward?] Captain Shannon said that vessels could have got more easily to sea from the westward, and there was a greater depth of water there. [In answer to the Provost, Captain Shannon said] He was decidedly of opinion that the west site would not have been equally convenient for the timber trade; would have been unsuitable for the Greenock Railway; unsuitable for the Caledonian traffic; and inconvenient for the passengers by the large steamers; is decidedly of opinion that the east site is in all respects the most suitable for the wants of the trade of the port. The bank shows no disposition

APPENDIX C.

GREENOCK.

No. 354.
Evidence taken on the 20th Oct., 1846.

to encroach on the west side. [In answer to Mr. Arbuckle] Thinks the erection of a breakwater on Garvel or Gemmell's Point would be apt to turn the channel, and perhaps send the water over to the other side of the bank.

Captain James ALLEN—Has been acquainted with the port for 43 years; for many years commanded vessels sailing out of Greenock, and is now harbour-master: since he recollects there has been a great increase in the foreign trade. The channel between the quays and the bank is getting deeper, caused by the greater scour of the river: the flood tide at first runs about three miles an hour; and at the last of the ebb about five knots an hour; the water during the ebb runs along the quays; the tide at the last of the ebb, when there has been heavy rain or much snow melted, brings down some dirt from the upper districts; but not much, and is easily kept from increasing. During the last eight years has heard many complaints of want of accommodation for the shipping at Greenock. The present harbours have been dredged as far as could be done with safety; indeed, it was believed that a part of the quays was moved at the foundation in the course of the dredging operations. Driving piles under them would have a bad effect by shaking the foundations and making the quays come out. The harbours now being constructed would afford great accommodation; they would supply berthage for eighteen large ships, one tier deep along the quay wall. The works, so far as he could judge, were not going on vigorously; understood they were to be finished in March, 1848; did not see much prospect of that unless measures were taken to push them on more actively than they had yet been; the works were carried on partly by hand, and partly, the soft part, by the dredging-machine. Mixes much with shipmasters, and thinks that a wet dock would be more generally acceptable than a tidal harbour; has heard of complaints of injury to the vessels in the harbour; was never examined by the engineer as to his opinion regarding the new harbour; has kept a gauge for some years; lent the record to Mr. Errington, civil engineer, who had not returned it; there has been a gauge kept in the East harbour for some time, by Commander Robinson, of Her Majesty's steamship *Shearwater*, for some purpose connected with the surveying of the river; Mr. Thompson, C.E., also kept one when making his survey; they are reduced to a datum line on the dock gates; spring tides 10½ to 11; neaps 8½ to 9; winds have a most material effect on the tides, making a difference of from 3 to 4 feet all up the Clyde; has seen repeatedly vessels for Glasgow detained at Greenock from want of water to carry them up the river; seldom or never has a ship neaped here. The bank has increased somewhat to the east, but can never block up the passage, there is so strong a scour in the river, and the channel on the other side is now filling up; vessels used formerly to pass up and down on the other side of the bank; none can do so now; this he ascribes to the dredging going on above Greenock. A breakwater on the bank might do good in saving the outside of the harbours, especially in high tides and easterly gales, and a breakwater on Garvel Point would do harm, as it would probably again open up the north channel, and throw the current out of the present channel. To construct a breakwater on the bank would cost a great deal of money, which might probably be the reason for its not being done. The construction of the harbours to the east is decidedly the best for the good of the town; to the westward would not at all suit the railroad, or the establishments for manufacturing marine machinery, &c. (those larger works being all placed near the east harbour), putting machinery into steamers for instance. Ships would have easier access to sea from the west, and the bank is at a greater distance; but this is of less importance, as nearly all vessels are now taken out and in by tugs. Knows nothing of the new railway quay; if thrown too far out would be most prejudicial to the present harbours by throwing off the scour of the river obliquely; if an open pier, would, of course, do less harm; would be very much disposed to encourage railways approaching the sea; no doubt the purchase of the Greenock line by the Caledonian Company would be of great advantage to the harbour by bringing more traffic here; goods, especially minerals, would be brought in large quantities to Greenock for shipment. There are four very fine graving docks, the town's new dock at the gates is 38 feet 6 wide; the old dock, 32 feet; Mr. Steele's, 38 feet 6; and Mr. Scott's, a very little less. Some of them are able to take in the largest steamers, the paddle-boxes being floated over the top of the gates. The Royal West India Mail steamers, 1800 tons, built here, were all docked and coppered in these docks. Their machinery was made by Messrs. Caird and Co., and Messrs. Scott, Sinclair, and Co., and put in by the large crane on the East India quay, which can lift from 50 to 60 tons; there is none equal to it in Great Britain. [Captain Allen then enumerated the various steamers now being built here.] The Halifax steamers have all been built in the Clyde, under contract from Mr. Napier of Glasgow, who builds the machinery, and puts it on board there, and is reported to be a large owner in the Company. Has frequently known and seen great injury done to ships in the river coming down loaded, getting aground on shoals and dykes; has repeatedly seen vessels have their false keels knocked off, get hogged, and otherwise injured. The *Mohawk* was much injured in this way; ships have repeatedly had to come in here to discharge and go into dock. The *Glenbervie* was some time ago much damaged, and was assured she had never touched the ground but in the river going up. She was docked here. Shipowners are naturally disposed to keep their vessels where they can have deep water; there is an inclination among shipmasters to stop here unless when owned by persons much interested in Glasgow. Giving increased accommodation would increase the trade; this he found to be the case everywhere. Fourteen feet depth could be easily kept in the new harbour by dredging and keeping out sewers which in some instances are allowed to run into the present harbours. Is of opinion that a floating harbour would be the best. The *Eglinton* was hogged and injured by lying on the ground, and on being overhauled in Mr. Steele's dock, the owners made complaints. The rise of water is less at Dublin than here, and no doubt means might be taken to overcome the difficulty of having wet docks here from that cause. [In answer to the Provost, Captain Allen said]—He was aware that the new harbours are being put up chiefly for the accommodation of large vessels, most of which are timber laden. Has seen from ten to fourteen ships discharging timber at one time; these would put out from 150 to 260 logs each a-day; would get these out lockful by lockful; the weather at times is such as not to admit of timber being removed, which would soon block up a dock; a week's discharge would do so.

The PROVOST thought that sufficient to show a tidal harbour to be preferable.

Mr. M'CLURE said this objection would apply as strongly against a tidal as a floating harbour.

[In answer to Mr. Todd, Captain Allen said]—In Liverpool vessels of all tonnage, drawing from 16 to 22 feet water, were put with their bow to the quay, and the timber hauled ashore; there was no room for this being done here, and it would be much more expensive, as not above one-twentieth of the timber imported into Greenock was used here; the remainder being floated to Glasgow and elsewhere at small expense; is not aware of the expense at Liverpool, but must be much greater; no more room could have been taken at the east. The width of the entrance of the new harbour was at

APPENDIX C.

GREENOCK.

No. 370.
Evidence taken on the 20th Oct., 1846.

first intended to be made 100 feet; but he understood it had been increased. The entrance of the present east harbour is 150 feet; of the west, 120; has at present often to keep ships at the entrance of the harbours from want of accommodation within. With an east wind there is a slight motion among ships in the harbour; does not think it desirable that the entrance should be wider than 100 feet.

The PROVOST explained that it was proposed to use the entrance to the new harbour as berths for large steamers, to admit of their going to sea at all times of the tide; for this purpose it was considered desirable to make the width 150 feet.

Captain ALLEN continued—Has known one or two instances of ships breaking loose in the harbours; but no damage was done; the pawls are all firm and good. There are six screw anchors placed by the Water Trustees in the roadsteads, 30 feet into the ground, as far as the metal would permit; one or two have come up from having fallen in with veins of soft mud; some of them within the harbours have been down fourteen years; those of the larger size, three years. The approach to Greenock from sea is perfectly easy, buoyed and lighted the whole way; the part below Greenock is under the charge of the Cumbray Lighthouse Trust, managed at Glasgow, and is sufficiently done. Attends board meetings when called on, and if he requires anything he applies to them; does not allow ballast to be thrown into harbour; enforces bye-laws, but they have not been posted up for some years, being out of print; has repeatedly applied for copies, but unsuccessfully.

The COMMISSIONER recommended Captain Allen to make another application, as, if anything went amiss, he as Harbour Master would be the person applied to. Unless they were posted up, in compliance with the Act of Parliament, no penalty could be enforced.

Captain ALLEN continued—Parties refuse to comply, not having them to guide them. The harbours are mostly crowded on the return of vessels from the spring voyages in June, July, and August, and again after the fall voyages in November and December.

The COMMISSIONER asked if Captain A. was aware that a wet dock must have caused much greater expense?

Captain ALLEN.—It is so said: but of this he was not a judge.

Mr. BLAIR asked if Captain A. considered it judicious to expend 120,000*l.* on the erection of a harbour for the use of timber exclusively?

Captain ALLEN was not prepared to give any opinion.

The PROVOST.—Captain Allen was aware of the great amount of shipping connected with the importation of timber that came to the port, did he not think it proper to expend that amount to prevent it leaving the port?

Captain ALLEN.—Decidedly. The east harbour would also be most convenient for large steamers getting in machinery; the most suitable for deep sea steamers that chose to remain here rather than go up the river; and the best for the Caledonian traffic, and for passengers generally.

Mr. BLAIR asked if Captain A. had ever been at any port where such a sum as was now proposed had ever been laid out in constructing a tidal harbour? or had ever been in any port where a tidal harbour had been constructed, excavated to the depth of 13 feet?

Captain ALLEN could not say.

Mr. BLAIR said there would be great difficulty in making and maintaining such a depth.

The COMMISSIONER said this was a public Court, and he would be glad to hear whatever could be said. He might remark, however, that the Trustees, who had heard all that could be said upon, and had maturely weighed the subject, and who also knew precisely the state of their funds, had much better opportunities of forming a correct judgment than any individual who had not the same means of judging.

Mr. BLAIR said he held that the Trustees had not done their duty, as the harbour-master had not been examined by them.

Captain ALLEN.—In saying so, Mr. Blair is quite mistaken; he had been frequently examined by the Trust and by the Harbour Accommodation Committee, and had furnished them with numerous reports and plans of what he thought most suitable. [In answer to the Commissioner, Captain A. said] Montreal traders and other vessels, drawing from 15 to 16 feet, had often to stop here for eight days waiting for water; they were often detained 14 days coming down, sometimes lying aground in very bad places; this was within his own observation; the *Fanny*, Capt. Harrower, besides others, after grounding coming down the river, had to discharge and go into dock here. He thought the dues too light here; it was not possible to make good harbours and keep low dues; but of course ship-owners and merchants were well pleased with the low dues. In Glasgow the dues on ships are light, while on goods they are as high as 1*s.* 6*d.* per ton; ships laid up at Glasgow pay so much per six months; here no additional charge is made though they should lie till they rot.

JOHN B. CUMMING, Esq.—Is Lloyd's Surveyor, and has been so for nearly 13 years. His duty is to attend to new ships building, and to ships under repairs, and report them to the Committee of Lloyd's Register at London for classification. Was nearly 30 years at sea; has known something of Greenock harbours all his life, and remembers seeing a particular ship being built there in 1798. The shipping of Greenock has greatly increased since that time. Ever since his appointment as Lloyd's surveyor, has transmitted to London monthly returns of all ships being built in this district. A few years ago these returns showed 25,000 tons for a considerable time, and by far the larger proportion at Greenock. He was the only surveyor for Lloyd's in this quarter until about eighteen months ago, and his district comprised the whole of the Clyde. A second surveyor was about that time appointed as his colleague. There is at Greenock every facility for shipbuilding—one is, its proximity to deep water. There is also excellent accommodation in the graving docks and patent slip docks. Of his own knowledge can testify of vessels being injured coming down the river loaded. The *Fanny*, Captain Harrower, two or three years ago, was in the dock here and put in good order; was taken to Glasgow to load, and in coming down got aground, as most vessels do, at low water; she lay badly, and was much strained; was surveyed after getting to the tail of the bank; found to be making much water; taken into harbour, and had to discharge her cargo and go into dock, when the copper was found to be much wrinkled and ruffled, false keel damaged, and the bottom much strained. The wind was fair when she got down, and had she not made so much water all at once she would of course have proceeded to sea. The river is deeper now than it was several years ago, but no vessel loaded, and drawing more than 14 or 15 feet of water, can go to Glasgow, or come down the river, in his opinion, without risk of damage, although many of them do escape. There will be a great additional accommodation for the trade of Greenock, when the harbours now in progress are completed; there is

APPENDIX
GREENOCK.
No. 370.
vidence taken on
the 20th Oct., 1846.

not enough of accommodation now; has seen much inconvenience arise from want of accommodation; considers a wet dock would afford the preferable accommodation for shipping. One difficulty here in forming a wet dock is the small rise and fall of the tide; the harbours now in progress are, perhaps, the best suited for the trade of Greenock at present; is of opinion that a wet dock at the west end would be desirable, if the trade of the port continue to progress; and the accommodation now being formed will no doubt tend to increase the trade. Has heard complaints of ships not being always water-borne, but does not recollect of any ship being injured in the harbours, unless improperly berthed; such complaints need not occur, in his opinion, when the new harbours are completed. Greenock is very easy and safe of access from and to the sea; and he has heard this remark made by eminent strangers visiting here for the first time, who were well qualified to give opinions thereon. Greenock-built ships have generally a very high character, and he is confident as good ships are built here as in any port in the world. Two large wooden steamers, of nearly 1800 tons each, are now being built in Messrs. Robert Steele and Co.'s yard. An iron frigate is also being built by Messrs. Scott and Sons, for Government, of about 1600 tons Three large iron steam vessels are being constructed by Messrs. Caird and Co., and several other smaller vessels by Messrs. Scott, and the other ship-builders, Mr. Barnhill, Mr. Mac Millan, and Mr. Duncan. There are nine building yards in Greenock, two of which are at present unoccupied.

The following statement was handed in, prepared by Mr. Balderston:—

Greenock, October 20, 1846.

"For your information, I may mention that Caird and Co. are at present building the following steam vessels:—

One of 1225 tons, hull now being rivetted.
One of 1000 tons, part of keel laid.
One of 850 tons, to be launched in two weeks.
One of 650 tons, in frame; and at Dumbarton,
Two of 700 tons collectively; besides, there are two steamers lying in the east harbour, one of which leaves this for Southampton on Thursday, 750 tons, and another for Drogheda next week, 650 tons; in all 5825 tons. The whole of the machinery is made by them, with the exception of the 1225 tons; it is to be put on board at Liverpool. They are also making about six sets of engines for steamers and flour mills, besides a large general business. The contracts for the last twelve months amount to from 160,000*l*. to 180,000*l*., and the wages paid at present will average every second week 2000*l*. Number of hands 1160, on Saturday last.

"Yours, truly, D. BALDERSTON."

Mr. CUMMING, continued.—Is decidedly of opinion that it would be safer for ships of larger size to remain at the lower ports; has known many ships besides the *Fanny* injured by going up and coming down the river deeply loaded—the *Mohawk*, for instance, and the *Jane Brown*, and many others he has examined in dock, after making their voyages, that had evidently been damaged by being dragged over the ground with powerful tugs. There is often serious detention in vessels getting up the river, as well as in getting out to sea, from want of water in the river; and he has heard many complaints of this from strangers coming to the Clyde. It would certainly be more advantageous to get to sea at once from Greenock, than have to wait loaded at Glasgow for sufficient water to get down, by which a fair wind is often lost, and the length of the voyage consequently extended. It is not the practice, in cases of vessels grounding in the river above Greenock, for a protest to be noted. This is done almost invariably in the case of ships getting aground below Greenock, and they generally put back to be surveyed; has known vessels, after being aground for several tides in the river, go to sea without inspection, and damage discovered in a number of cases afterwards. In one case of this kind, some years ago, a vessel bound to the West Indies had been ten tides in getting down the river; the owner insisted on her going to sea, very much against the wish of the charterer, who requested that she should be surveyed in the dock. The owner, however, did not agree to this, and she did go to sea without being docked; has no doubt she was insured. Knows several vessels that have been sailing to and from Greenock for twenty years, and are still in good condition. One, the *Christian*, trading to Jamaica, is 27 years old, and has never yet required a thorough repair, although occasional repairs, from time to time, have been performed as required. This is by no means a solitary case. [In answer to Mr. W. Martin, Mr. C. said]—Does not know the reason, although he believes it to be the invariable practice, why it is that vessels touching the ground below Greenock must put back to be surveyed, while those ships grounding above Port Glasgow do not require this. If they do ground below Greenock, and go to sea without being surveyed, they no doubt do so at the risk of vitiating their policies of insurance.

THOMAS HAMLIN, Esq.—Is a merchant and shipowner in Greenock. Was for years a shipmaster, and during part of that time sailed into the port. Has for many years observed the injury done to ships by grounding in the river. [Mr. Hamlin put in a pamphlet on the subject published by him a few years ago.] Knows of many other cases of injury to ships besides those therein published. He mentioned the case of the *Nelson*, a fine ship built at Dumbarton: went to Glasgow to load for Bombay, and filled up here; he shipped a quantity of goods in her which he did not insure, and which were seriously damaged. Saw her on her return to London, when it was found that her false keel had been knocked away, a large portion of her copper rubbed off, and her keel injured. The ship had not touched the ground after she left the Clyde. A good deal was said about the injury to this vessel. Great progress had, during the last few years, been done in the way of deepening the river; but there were great boulders and dykes still there, rendering the passage of ships to Glasgow, drawing more than fifteen feet water, precarious. There is a stone dyke above Erskine, several hundred feet in extent, of the same hard material as was found in the tunnel on the Greenock railway—this is a very rough rugged spot, where vessels cannot expect to be grounded without injury. Knows of many other vessels injured in coming down the river loaded—the *Mohawk*, *Jane Brown*, *Glenbervie*, *Akbar*, &c. The commanders of the steam tugs think nothing of ploughing along if they have depth within six inches of the vessel's draft of water. The owner of the *Akbar*, when he (Mr. H.) drew attention to that vessel, thanked him for doing so, but wished that in future he should attend to his own business; but when the vessel was put into dock on her return it was found that she had not been noticed without occasion. In passing up and down the river, has very frequently seen numbers of vessels aground—from about a mile above Port-Glasgow to Govan. About seven weeks ago, saw an American ship coming down in tow of a steamer; when opposite Dumbarton, and going at the rate of four knots an

APPENDIX C.

GREENOCK.

No. 354
Evidence taken on the 20th Oct., 1846.

hour, she suddenly stopped, having grounded. This occurring so suddenly something must have given way. Knows that vessels are frequently detained in Glasgow loaded, as the very wind that carries vessels from Greenock sends away the water from Glasgow, preventing ships getting out. Thinks the additional accommodation now in progress at Greenock much needed, and when completed, sufficient at present for the wants of the port; but anticipates that the trade of the port will be greatly increased by the railway traffic, and that another harbour will soon be required. The best kind of accommodation would, in his opinion, be a tidal harbour at the east end, and wet dock, with a tidal basin to the west end at the Bay of Quick, if the trade should increase. Approves of the present works, which are the most suitable for the timber trade; thinks it judicious to make and retain a depth of 14 feet or thereby. Was at sea for thirty years, and Greenock is the easiest of access, and the safest port, he knows of. The pilots complain of not being sufficiently employed; they are twenty-four in number; were they less numerous they might find ample employment in piloting foreign vessels; is not prepared to say it should be compulsory on all ships to take pilots, as the tug steamers go so far out, the masters of which are pilots.

The PROVOST said they could bring forward a great deal more evidence of the same kind: but he thought what had been adduced sufficient, as he was unwilling longer to encroach on the time of the Commissioner. He wished, however, to hear from their member in Parliament, Mr. Baine, the proceedings of the Trust in regard to the construction of the new harbours, as, at the time they were resolved upon and the Act obtained, he was Chairman of the Trust.

Mr. ANDERSON expressed his surprise at the delay that had taken place in the publication of the survey of the river made by the Admiralty, and asked if the Commissioner could give any information regarding it.

The COMMISSIONER said he understood these surveys were all but completed: the part of it which related to this part of the river was quite finished. He should recommend an application to the Admiralty on the subject. The banks in the Clyde were not to be trifled with.

Walter BAINE, Esq., M.P.—At the time he was Chairman of the Harbour Trust, there was great demand for additional accommodation for the shipping of the port; the complaints were incessant regarding the inferiority and insufficiency of the accommodation afforded to vessels of large tonnage. The first step of the Trustees was the appointment of a Committee to enquire into the matter; this Committee considered the subject very fully, and examined many witnesses. Their determination they embodied in a long report which they made to the Trust. By this body the subject was again maturely weighed, and eventually it was unanimously resolved to apply for the Act of Parliament passed in 1842. As something had been said about whether a floating or a tidal harbour should have been preferred, he would read the part of the report given in to the Trust by the Committee appointed to inquire into the necessity of additional harbour accommodation, showing the reasons why a tidal harbour was preferred.

"The question now to be considered is, whether a wet dock or a tidal harbour is the most suitable to the present circumstances of this port. The superiority of a wet dock, in allowing the ships therein to be kept always afloat, and in affording the whole of its area instead of the mere range of the quays, for the reception of shipping, is plain and indisputable. On the other hand, the limited range of tide at this port is an objection to the formation of docks here, which does not apply to Liverpool, and various other ports, where such accommodation has been provided, for, with a rise and fall of tide seldom exceeding ten feet, the gates of the dock must be always about two-thirds under water; consequently, the repair of the works, when from accident or decay repairs become necessary, must be difficult and expensive, and may at times be impracticable without having recourse to the construction of a coffer dam. The same cause, namely, the limited range of tide, lessens in another respect the advantage of a wet dock as compared with a tide harbour; for, assuming the latter to have, as proposed by the plans of Messrs. Hamilton and Allison, a depth of 24 feet at high water, it will not even at low water have less than about 14 feet: consequently, the vessels therein will at all times of the tide be so far water borne, that with ordinary care and attention, they can scarcely incur the smallest risk of damage. It is further to be kept in view, that the harbour room to be allotted to steamers, should if possible be accessible to such vessels at all times of the tide, as their arrangements do not admit of delay. Now, a tide harbour, of about 14 feet at low water would afford this accommodation to steamers of the largest class, whereas a wet dock cannot be entered or departed from, unless at or near the time of high water. This is an important consideration as regards the accommodation of steamers. A tide harbour is besides much less costly than a wet dock, and would not involve any increase of the existing harbour rates. It could also be constructed in less time, a consideration of some importance in the present circumstances of this port. Taking all these points into view, the Committee are of opinion, that to meet the present wants of the trade, a tide harbour of a depth of 24 feet, or as near thereto as practicable, ought to be preferred to a wet dock. It may be here observed, that whatever depth of water can be had for a wet dock, the same can be had for a tide harbour; and that neither for the one nor the other can the requisite depth be obtained, otherwise than by excavation within the dock or harbour, and by dredging outside, to form an approach from the channel of the river.

"The Committee, in thus recommending a tide harbour as the most suitable at the present time, would also recommend that the Trustees should keep in view the expediency of purchasing, if they can on reasonable terms, such shore-ground as may seem most suitable for docks, that they may have it in their power to form such accommodation, when an extension of trade shall render it desirable."

These were the reasons for preferring the tidal harbour, and although not stated in the Report, the accommodation of the timber trade had also some weight. The reasons for preferring the east site he might also read:—

"Observations of the Harbour Accommodation Committee on the Report of Joseph Locke, Esq.

"Mr. Locke estimates the cost of East and West Harbours as follows:—

East Harbour, covering the space between the present harbour and Mr. Steele's yard—6 imperial acres—depth 24 feet	£55,000
West Harbour, commencing at the West Burn and running from thence westward about 1200 feet, bounded on the south by Clarence Street—8½ acres depth 24 feet	80,000

"Mr. Locke at the same time states, that a reduction of the extent of the West Harbour would be attended with a corresponding reduction of the cost; it therefore follows that, for harbours of equal

Appendix C.

Greenock.

No. 370.
Evidence taken on the 20th Oct., 1846.

extent, east and west, the cost, exclusive of ground, would be about equal. It would be improper for the Committee at present to put a valuation upon the ground of either site, but it may be assumed that, in that particular, the one site would not have any very decided advantage over the other. Mr. Locke does not anticipate any difficulty in obtaining the requisite depth of water—24 feet—at either site; and although he refers to the borings as indicating a less favourable foundation for the sea-wall to the eastward, he seems to be under no apprehensions on that account. Upon the whole, the Report of Mr. Locke does not contain any thing at variance with the views which the Committee submitted in their Report of January last, upon the comparative advantages of the two proposed sites; and, so far as regards the accommodation of the various classes of shipping, *exclusive of steamers*, it perhaps would not be of much importance which site should be selected for the commencement of harbour extension. The Committee, however, having further considered the subject in reference to the case of steamers, are induced to offer now a more decided opinion than they formerly did, on the question of site. In their former report they suggested, that 'if the ships in the timber trade could be transferred to a new western harbour, the present east harbour would then perhaps afford sufficient accommodation to the steamers connected with the railway.'

"In regard to this suggestion, it is to be observed, that, so long as the Liverpool, Dublin, and other channel steamers continue merely to touch at the *outside* of our quays in passing to and from Glasgow, the present east harbour, especially after the erection of the proposed platform, may afford them sufficient accommodation; but if any such steamers are to make this port their starting point, and are to load and discharge here, they will require berthage *within* the harbour, and they cannot be properly accommodated unless such berthage be accessible to them at all times of the tide. This advantage the present east harbour cannot give. It has, inside, only two berths suitable for the steamers in question, viz., those along the north wall, and from deficiency of depth, the one of these berths is inaccessible to such vessels from one to three hours, and the other from four to six hours of each tide. This deficiency of depth cannot be remedied but at great expense; indeed, it cannot be remedied at all, unless a new harbour be first formed, which can be used as a substitute while the process of deepening is going on. But even on the supposition that the channel steamers are not to stop here, there is another class of steamers for which the want of accommodation is only now beginning to be felt, namely, the over-sea steamers built at this port, and requiring harbour room while taking in their machinery, and fitting out for their respective stations. To such vessels it is of essential importance that they should have berthage where they can be at all times water-borne, or nearly so, but in the present harbour such berthage cannot be had.

"From these considerations, it is evident that it is only in an additional harbour that either of the two classes of steamers referred to can be properly accommodated, and a western harbour would not suit them. To the channel steamers, proximity to the railway is indispensable, and to both channel and over-sea steamers it is of great importance to be near the founderies: for, independent of the inconvenience of having to send the workmen from these establishments to a distant point, it must be obvious that the conveyance of large boilers, and pieces of machinery of from 20 to 30 tons weight, through our narrow and crowded streets from the east to the west extremity of the town, would not only cause great trouble and expense to the parties concerned, but would also be a source of much annoyance to the public, and would indeed be attended with danger to both life and property. Seeing, then, that under present circumstances, it is only at the east site that suitable accommodation for steamers can be combined with increased accommodation to the general trade, the Committee have no hesitation in offering a decided opinion in favour of that site, and they accordingly recommend that application be made to Parliament, as soon as practicable, for authority to carry into effect Mr. Locke's plan of harbour extension in that locality; and, keeping in view the probability of a progressive increase of trade, they would further recommend, in accordance with the suggestions of Mr. Locke, that powers be applied for, also, to purchase the ground included in the western plan, that the Trustees may be enabled to proceed in the execution of that plan when required.

"12*th May*, 1841.

W. Baine, Jun., *Convener*."

The report and observations just noticed contain the reasons which induced the Trustees to prefer the tidal harbour, and the adoption of the eastern site; but to provide for the further increase of trade, power was taken in the Act to construct docks, and also to extend their accommodation to the westward so soon as required, and the funds of the Trust might warrant them in going into such works.

The Commissioner said it was evident the matter had been very fully and maturely considered by the Trustees, and that in the works they had resolved to construct they had followed the recommendations of the engineer, and studied the wants of the port. There would be opposition everywhere, and it was perhaps good it should be so.

Mr. Baine said the Harbour Accommodation Committee had been unanimous in their recommendation, and the Trustees had unanimously approved of the report. The Commissioners on the harbours, though not part of the Trust, had sanctioned the kind of harbour and the expenditure necessary for the works.

Capt. M'Intyre, master of the *Charlotte Harrison*, brought that ship down from Glasgow in 1845; she was drawing 14½ feet of water: left Glasgow on the top of the highest spring tide. On the way down a steamer going up the river threw the water from her bows, and she struck the ground heavily. She had emigrants on board for New York, and the Government agent came on board the vessel off Greenock. When the ship had been a fortnight at sea she began to make water very badly, and indeed it required all on board to keep her afloat; the water began to come in as soon as she got fairly to sea. On going into dock at New York, it was found she had got knocked off 30 feet of her keel and her forefoot; he brought home the remains of the part of the keel damaged, and it is still, he believes, in Messrs. Scott's yard (12 feet were knocked away). His idea was, if the vessel had had to go a long voyage, or only the crew had been on board, that they must have been compelled to leave her, and then it would have been said that she had been unseaworthy when she sailed. A large stone was taken out of her bows at New York, which was to have been sent home to Lloyd's; her repairs cost 380*l*., besides, from the time expended repairing damage, throwing the vessel out of her intended full voyage.

James Tasker, Esq.—Is a merchant and shipowner, and Managing Director of the Glasgow and Greenock Railway, which is about to be amalgamated with the Caledonian line; has for several years paid much attention to railway matters. A new pier is about to be erected by the Railway Company to the eastward of the present harbours of Greenock, to be applied to the shipment of minerals. The quantity of coal shipped last year in the bay of Ayr—that is, from Troon, Ardrossan, and Ayr—was

APPENDIX C.

GREENOCK.

No. 370.
Evidence taken on the 20th Oct., 1846.

about 300,000 tons; Lanark coal is reckoned more valuable than the Ayrshire by about one shilling a ton. It is impossible to form any calculation what may be the amount of increase of traffic after the railways now proposed are connected throughout, and the proper means of easy shipment of minerals provided here. Thinks it improper to have the shipment of coal going on alongside that of other goods, if they can at all be kept separate. The purchases of ground required for the railway pier at Greenock are now being made, with a view of having it completed by the time the Clydesdale Railway is opened. The engineer of the new pier is Mr. Locke, who laid plans of the work before the Admiralty, and obtained their sanction for its being constructed. The directors of the Greenock Railway have always been satisfied of the advantage of their junction with the Clydesdale and Barrhead, which have now become the Caledonian; and so convinced are they of the great increase of traffic which will ensue, that they have offered to the authorities of Port-Glasgow to construct a new pier there also, so as to connect this railway with their harbour, which, with the consent of the Harbour Trustees, can be formed without an Act of Parliament; but we understand this offer is likely to be declined by the authorities there, as it would interfere with a favourite scheme; some of the parties there also wish a continuance of the railway from the Bridge-of-Weir, that taken up by the Ayr Company, and which is a rival line to the Greenock. The connection betwixt this railway and the Port-Glasgow harbours could be formed at small expense, and would give great accommodation for the shipment of minerals, as well as of general goods. Was perfectly satisfied that the additional accommodation now forming by the Greenock Harbour Trustees was much wanted, indeed, at the time there seemed to be some hesitation about the Trustees' proceedings, he had consulted some of the gentlemen deeply interested in the Caledonian Railway as to purchasing the harbours for that Company, and he was satisfied that that company never would have amalgamated with the Greenock unless the new harbours had been in progress. The connection between the railway and the harbours was not at present good, but a proper junction would be formed by the time the harbours were completed. The depth of water at the site of the proposed railway pier was not much at present; but they would excavate to the required depth. The pier was to be in a line with the river wall.

The COMMISSIONER said it ought not to be permitted to project farther.

Mr. TASKER continued.—It was not finally fixed of what material it would be constructed, but probably of wood. He had had occasion to turn much of his attention to railway matters, and was satisfied that traffic to a very large amount would come to Greenock for shipment on the completion of the lines now in progress to the eastward of Glasgow. The Caledonian line guarantees a dividend of 4 per cent. to the Greenock shareholders. The additional traffic he anticipated was not confined to minerals, but applied to sugar, and indeed goods of all kinds. Trucks loaded here would be able to go without stoppage or change, and discharge at Leith or any intermediate place.

Mr. ANDERSON said he might mention one case. The house of an extensive concern in Greenock usually sent to the East country about 200 tons a week of sugar. Cargoes of sugar were imported here and afterwards forwarded to the East country when refined.

Mr. TASKER continued.—Hemp might also be brought through direct, and bonded goods could be moved from the one coast to the other. He anticipated that many of the steamers would remain here. [Mr. T. then exhibited plans of the proposed railway pier and works.]

The PROVOST said he might take the opportunity to refer to the slow progress that seemed to be making with the new harbours. When Mr. Locke was here the other day his attention had been called to the subject, although the magistrates had no wish to interfere with the contractors, who were men of great respectability. Two of the contractors had been here for some days, and they had expressed themselves as greatly disappointed at the small progress that had been made with the works. They had now, however, resolved to set to work most vigorously, and they were still in hopes that the harbour would be finished in time. He might add that arrangements were making for carrying out their intentions.

THOMAS O. HUNTER, Esq.—Is agent for Lloyd's, and is extensively engaged in shipping; has been acquainted with shipping of Greenock for twenty years, and knows there has been a great increase of vessels frequenting the port, especially of timber-laden ships. Has heard many complaints regarding the want of accommodation; heard opinions in favour both of floating and of tidal harbours. As agent for Lloyd's would have heard of damage done to ships. The approach to Greenock from sea is quite easy; it was a common saying that if they kept off what they saw, there was no danger in making the port. The dues of the port are remarkably light, especially of late, as a deduction of about 20 per cent. had been made, saving 1500*l.* to 2000*l.* a-year to the shipping. The accommodation now in progress will, when completed, be ample for the present demands of the port; wet docks are not needed, as with 13 or 14 feet at low water ordinary sized vessels will be almost always afloat, and even large ships, as they do not lie long with full cargoes, will be generally afloat and always waterborne. Is aware of ships going up the Clyde being frequently detained here waiting for water: is well aware of ships being damaged coming down the river loaded; but is not prepared to speak to particular cases. Was agent for the *Nelson* at the time she was injured, as spoken of by previous witnesses, but was not aware of it at the time. Has heard no complaints against the pilots; has frequently heard pilots complain of want of employment: from the distance the steam-tugs go out with ships going to sea, and to meet ships arriving, pilots are not much needed. It was part of his duty to keep lists of foreign sailings and arrivals, and of shipping news generally, and to forward them to Lloyd's daily. Knows no port where the dues are lower than at Greenock. Never knew of any damage done to vessels here. The *Eglinton* that had been mentioned was damaged by being wrongly berthed: a ship of such length should not have been laid at the end of East India Quay, especially as there was excellent berthage alongside the wooden wharf, which was constructed for the special benefit of ships of large tonnage such as the *Eglinton;* believes the vessel was hogged or broken backed long before the time spoken of, as she had that appearance when she was laid up for sale west of the Custom-house. Never heard of ships being injured by surge coming into the harbours.

JOHN MARTIN, Esq.—Has been Town Chamberlain and Treasurer to the various trusts connected with the corporation for two years and a half. Has given security for his intromissions, as has the Collector of Harbour dues. The accounts of the various trusts are kept separate. Auditors are appointed by the Trust, and the Commissioners on the Harbours are also empowered by the Act to audit the books. The gross revenue of the Harbour Trust last year was 14,400*l.* None of the Trustees can take contracts for work: this is provided by the standing orders, not by Act of Parliament.

The COMMISSIONER looked over the several books kept by the Treasurer, and said, so far as he could give an opinion on a cursory examination, they were accurately kept, and duly signed.

APPENDIX C.

GREENOCK.

No. 370.
Evidence taken on the 20th Oct., 1846.

Mr. MARTIN continued.—The debt of the Trust at the balance in September last was 110,070*l.* Property purchased with a view to harbour extension, but which might be sold without injuring the old or new harbours—money in the bank and funds available, 45,737*l.* Property purchased for the site of the new harbour, and payments made to contractors and others for the same, 23,009*l.* In all, the available funds and new harbour stand at present, 68,746*l.*, leaving a net debt of 41,324*l.* against old harbours. In 1824, the gross debt against the Trust was 128,000*l.*: the available funds were 8,000*l.*, leaving a net debt of 120,000*l.*; and in 1846 the net debt was 41,324*l.*, after deduction of the cost of new harbour and available funds. Within the last twenty-two years the Trust had therefore reduced its net debt about 79,000*l.*, and in the same period had expended besides upwards of 20,000*l.* out of the profits, in the extension of works, and in procuring Act of Parliament. In this last, much expense had been incurred by the opposition of the Glasgow Trustees.

Mr. BAINE said the expense of procuring the Act for the new harbours was 3000*l.*, a very large proportion of which was incurred by the determined opposition of Glasgow.

Mr. MARTIN said the surplus revenue of the trust last year was 5,718*l.* The contract for the new harbours was 90,000*l.*, besides ground and compensation. They would probably cost in all from 110,000*l.* to 115,000*l.*, exclusive of the wall at the west, which would cost 11,000*l.*

Mr. ANDERSON begged to call the attention of the Commissioner to the defenceless state of the port: he had heard how accessible the river was, and there was no protection whatever against the encroachments of an enemy. The Chamber of Commerce had petitioned the Admiralty on the subject, and had been informed that it had been referred to the Board of Ordnance, and there it had remained, no more having been heard of the petition.

Mr. JOHN MILLER.—Has been a pilot on the river Clyde for seven years; was shipmaster thirty years before that. A memorial has been handed in to the magistrates by the pilots complaining of not being sufficiently employed, and the answer was that the authorities had no power to enforce the taking of pilots.

The COMMISSIONER said that Mr. M. would have heard from the evidence that some of the gentlemen examined were of opinion that the taking of pilots should be compulsory; it was no part of his duty to enforce this; but he should bring it before the proper quarter.

Mr. MILLER continued.—The pilots kept boats of 20 and 24 tons, and maintained crews at an expense of 8*l.* per month at least, and risked their lives in boarding vessels to bring them up in safety; they frequently went out to the coast of Ireland looking for ships arriving. They were bound at all times to give assistance to ships desiring aid, but it was optional with the commanders to take pilots or not as they pleased. If a pilot once goes on board a vessel he must remain there till the ship is moored in safety, and however long that may be the pilot gets no pay beyond the rates of pilotage, which are low.

The COMMISSIONER said, it appeared the present Board had not powers to comply with the prayer of the petition sent in by the pilots; as he had said, it was not within his province to enforce a regulation compelling ships to take pilots; but this he would say, that the memorial should appear with the other evidence, and though he could not guarantee that the prayer would be complied with, yet he would assure them it would be taken into consideration.

Mr. MILLER continued.—Being a deep-sea pilot he takes vessels no higher up than Port Glasgow; all further up are taken by tug-boats, the masters of which are river pilots. Has in going up and down the river frequently seen vessels aground—in every part of it from Govan to Port-Glasgow Bank. The *Fanny*, Capt. Harrower, a few years ago, sustained serious damage coming down the river, and was brought into dock here. There is no difficulty in bringing up vessels to Greenock; the buoys and perches are quite sufficient. Is sure the Greenock bank is increasing on the east towards the quays. The tide sets fair along the quays at the rate of 3 knots an hour spring-tides, 1½ knots neap-tides. Perfectly agrees with previous witnesses as to want of accommodation at Greenock, but which he thinks will be sufficiently provided for when the new harbours are finished. East and north-east winds cause a fall of 4 or 5 feet of water in the river, and thus stop vessels coming down. Vessels sailing from Greenock have thus frequently a considerable start of vessels coming down the river. Has known vessels detained ten days at Glasgow waiting for water, and has known ships lying aground in the river for ten days. Is aware of one case where a ship left Glasgow with the spring-tides, and the wind having taken off the water, she lay ten days on the ground near Dumbarton, although her cargo was taken out of her. There is only one place in the river, close to the north perch above Port-Glasgow Bank where a vessel may lie afloat. The *Mandarin* did not come into the dock here after she had been aground in the river, but went to sea. She never returned, having in all likelihood foundered at sea. Has never known an instance of vessels breaking adrift in the harbour here since chains were introduced, and if they were properly secured. A breakwater on the bank would be an excellent thing, as ships would then be able to lie as quietly at all times in the roadstead as they do inside the harbour. Vessels now ride out gales in the roads without injury.

Mr. WILLIAM ALLISON exhibited to the Commissioner the plans, &c. of the sea-wall now in progress at the west end. It was intended to form a space of three acres for timber, deals, &c., and to construct quays where vessels drawing 16 feet water could discharge timber, &c.

Provost FAIRRIE, in conclusion, said, that on no matter could the people of Greenock be more jealous than of any interference with their management of the harbours, and if any such were attempted he was sure a great outcry would be raised.

The COMMISSIONER said, he could assure the gentlemen present that there was no intention whatever on the part of the Tidal Harbours Commission to take any power over the harbours out of the hands of the local boards, by whom they could be best managed. The object of their appointment was to inquire into the past and present state, and the future capabilities of the tidal harbours throughout the country. Where everything was properly managed, there was no reason to fear investigation. He might mention one advantage that would result from the inquiries of the Commission: in the event of any improvement being considered desirable by the local boards, the matter would be inquired into by the proper authorities; and on being approved of would be brought forward as a Government measure, and the expenses of procuring bills which now fall so heavily on the local boards would be entirely saved, and the money could be expended on their improvements, an infinitely more legitimate purpose, he thought, than being spent on solicitors and officers of Parliament. He hoped the trade of the port would go on increasing till they required floating as well as tidal harbours, and additional accommodation to the west as well as to the east.

The Commissioner thereafter proceeded, along with the Town Clerk, to look at the improvements now going on at the West end.

No. 371.
Return of Acts and Charters relating to the Harbour.

No. 371.

Titles of the Acts of Parliament and Charters relating to the Harbours of Greenock.

I.—TITLES of the several Acts of Parliament relating to the Harbours of Greenock.

13 George III. cap. 28. "An Act for deepening, cleansing, and making more commodious the Harbours of the Town of Greenock, for supplying the Inhabitants with fresh and wholesome Water, and for paving, cleansing, lighting and watching the Streets and other Public Places within the said Town."

29 George III. cap. 43.—"An Act for altering and enlarging the powers of an Act made in the thirteenth year of the reign of His present Majesty, intituled "—(See preceding Act.)

41 George III. cap. 51.—"An Act to amend two Acts made in the thirteenth and twenty-ninth years of the Reign of His present Majesty, for making more commodious the Harbours of the Town of Greenock, and for other purposes mentioned in the said Acts; for watching the said Town, and better supplying the same with Water; for regulating the Fares of Coachmen, Chairmen, Porters and Carters plying in the said Town; and of Pilots, Watermen, and Jobbers employed in the said Harbours and on the River Clyde, and for feuing out the Glebe of the said Town."

43 George III. cap. 87.—"An Act for the further Improvement of the Harbours of the Town of Greenock, and for other purposes therein mentioned."

50 George III. cap. 167.—"An Act for altering and enlarging the Powers of several Acts of His present Majesty, for the Improvement of the Town of Greenock and the Harbours thereof; for regulating the Police, and for other purposes mentioned in the said Acts."

57 George III. cap. 32.—"An Act for the further Improvement of the Town and Harbours of Greenock; for establishing and supporting a Harbour Police, and for the better regulating the poor of the three Parishes of Greenock."

3 & 4 Vict. cap. 27.—"An Act for the further Improvement of the Town of Greenock; for better lighting and supplying the same with Water; for regulating the Police thereof, and for other purposes connected therewith."

5 Vict. Session 2nd. cap. 54.—"An Act for further improving, enlarging and maintaining the Harbours of the Town of Greenock."

II.—Titles of the Grants from the Superiors of the Shore, Bay, Ring, and Anchorage Dues.

"Feu Contract between John Shaw Stewart, Esq., of Greenock, on the one Part, and the Magistrates and Councillors of Greenock on the other Part; dated 13th and 16th May, and recorded in the Books of Council and Session, the 6th day of July, 1772."

"Contract of Feu between The Right Honorable Charles Lord Cathcart and the Magistrates and Town Council of Greenock, dated 3rd and 26th March, and 17th July, 1773."

III.—Title of the Charter of Erection.

"Charter of Erection by Sir John Shaw of Greenock, Bart., in favour of the Feuars, Subfeuars and Burgesses, of the Burgh of Greenock, dated at Drummore, the 2nd day of September, 1751."

JOHN KERR GRAY.

No. 372.
Rennie, on proposed Wet-Docks at Bay of Quick.

No. 372.

Report by J. RENNIE, Esq., C.E., *respecting projected Wet-Docks at Bay of Quick.*

London, July 10, 1802.

GENTLEMEN,

AGREEABLY to your request, I examined the harbour of Greenock on the 7th and 8th of August last, and gave the necessary directions to Mr. Ainslie, respecting the surveys and soundings, which he has since completed and sent to me.

The Frith of Clyde runs in a direction nearly W.N.W. and E.S.E., in that place on which the town and harbour of Greenock are situated; but about four miles to the westward it bends to the southward, and becomes nearly due south and north. The land on the east side is pretty high, but on the west side it is very mountainous: Loch Long is opposite where this sudden bend takes place, and stretches nearly north for about 10 miles: about 3 miles to the eastward of this, and opposite Greenock, the Gair Loch stretches inland about six miles, in a direction nearly N.N.W., and there is a bay north of the town about 4 miles wide, but this width does not continue far, for at Port-Glasgow it is not above 2 miles wide.

In the river or frith, from Greenock upwards, are several very extensive sand banks, which have channels or swatchways across them, through which the flood tide directs its course; but being so much obstructed by the island of Bute and Cumbrae, and by its changed direction at the point of Roseneath, and by the fresh water sent down by the Clyde, its velocity is greatly impeded. In the first quarter of flood, when it is the strongest, it does not move above one knot per hour, and with a direction opposite Greenock rather more southerly than the line of the shore. Fears have therefore been entertained, that it would in time form a new channel at a considerable distance from the shore, which would greatly injure, if not destroy, the harbours of Greenock and Port-Glasgow. Its tendency no doubt is to produce this effect, but luckily the Clyde and Leven counteract this tendency; for between Kilpatrick and Dumbarton, the channel lies in a direction W. and by S. and E. and by N., which throws it to the southward, and the Leven joining below Dumbarton in a S.S.E. direction, tends still more to force it along the Renfrew side, so that by this means there is an excellent channel maintained along the whole northern shore of the county of Renfrew, and as at the last quarter of ebb it runs with a velocity of about three knots per hour, its grinding power produces a much greater effect than in the flood. The current of the flowing tide being therefore on the north side, and the ebbing being on the south side, there have been two great sand banks formed in the middle channel, the one opposite Port-Glasgow, called the Cockle Bank, and the other opposite Greenock, called Greenock Bank, both of which are dry at low water spring tides; and there is a channel between, in which there is a considerable depth of water. These two banks are in some respects an injury to the harbours of Port-Glasgow, and Greenock, as they prevent vessels from working out in contrary winds with so much

APPENDIX C.

GREENOCK.

No. 372.
Rennie, on proposed Wet-Docks at Bay of Quick.

advantage as they otherwise would, were no such banks there; but the benefit arising from them is greater than the injury, for they are not only the means of maintaining the channel deep, by confining the ebbs into a narrow compass, but they act as breakwaters to shelter the harbours; and therefore, although the width of the Clyde opposite to the town of Greenock, as I have before stated, is 4 miles, yet there is never any heavy swell or sea, which materially affects the harbour; so little is the swell that vessels, during a considerable part of the year, can load and discharge their cargoes outside of the piers. I have entered into this dissertation, not for the purpose of giving information to those mariners who trade to and from the ports of Greenock and Glasgow, who I doubt not are better acquainted with the set of the tides than I am, but for the purpose of showing how important it is to attend to these important facts, in laying down a plan for the improvement of Greenock harbour; where no work should be constructed that has the smallest tendency to change the direction of the tides or sand-banks, which nature has so wisely formed for making and maintaining a deep entrance to two of the most important harbours on the west coast of Scotland.

With these important considerations before me, the plan I have to propose for the New Eastern Harbour, and for the amelioration of the Old, is to make the piers as nearly parallel to the great bank opposite to the harbour, as the nature of the situation will admit.

The harbour in the bay of Quick being to the eastward of the great bank, need not be scrupulously formed, as the channel here widens; but still nothing should be done materially to obstruct the entrance of the flowing tide, which should be enticed into it, if I may be allowed the expression, as much as possible.

The ground to the eastward of the present new quay, is of a shape which renders it difficult to be converted into a harbour of a convenient and uniform shape. The extent is also very limited: the expense therefore becomes great in proportion to the accommodation which can be gained.

I have studied this situation with considerable attention, but I cannot say I have been able to satisfy myself in respect to the best form of constructing a harbour:—The plan which has occurred to me, is nearly the same as was proposed by Mr. Ainslie in his former survey; namely, to build a quay or pier 100 feet wide, parallel to, and close by, the Daling Burn, which is the boundary of the powers granted by the Act of Parliament, and extending about 240 yards from the bridge.

From the extremity of this pier, I propose another, nearly at right angles and parallel to the great bank, of 60 feet in width and 150 yards in length: I propose the new quay to be extended about 66 yards beyond the present pier, and of the width of 40 feet; this will leave an opening, between it and the other, 50 yards wide, which I propose as the entrance or opening of the harbour. It may be asked, why not have extended the eastern pier 66 yards farther, and made the entrance to the harbour at the end of the present new quay? To this I answer, that in the first place the harbour is so narrow at the present pier, that there is very little room for ships to get out of and into it—and in the second place, that it is so narrow there is not sufficient room for the waves to spend their violence before they reach the breast of the inner quay, which would render the harbour very unquiet, and of course be detrimental to the vessels lying in it.

I propose a breast wall to be built from the east end of the east quay to that at the Daling Burn, which will close nearly 9 statute acres of water, and give about 1000 yards in length of quay. The quay next the town is proposed to be 100 feet wide, as well as that parallel to the Daling Burn; the bottom of the harbour, which is now dry at low water, is proposed to be deepened to about 2 feet under it.

The space between the breast or quay wall and the shore, is intended to be filled with earth, and the piers are proposed to be formed by an out and an inside wall, with counterforts, having the space between filled with earth and paved over; this filling will consume about 112,000 cubic yards of earth more than will come out of the harbour; this earth must be brought from some other place not very distant from the harbour.

I do not propose to have any middle quay, or tongue, in this harbour, as upon comparing the extent of quay with the quantity of water, the one seems fully equal to the other. A harbour should always have some room for those ships which are in ballast, or such as are laid up for the winter, or are waiting for repairs; and after the whole quays are occupied by such vessels as will be loading and discharging their cargoes, there does not seem to be more space left than is necessary for the accommodation of such vessels as I have before mentioned, and others moving to and from the quays.

A dry dock was proposed by Mr. Ainslie in the south-east corner of this new harbour. I have however thought proper to leave it out here; as a dry-dock in this situation would occupy nearly 130 yards of the best part of the quay, and would be a great inconvenience to the harbour; besides, there would not be sufficient room around it to contain timber for such vessels as may want repair. I therefore propose that two dry docks should be made to the west of Mr. Scott's ship yard, as will afterwards be described; but should any very material objections arise against this situation, a dock may still be made in the east harbour.

The second part of the plan is that of enlarging the present quay by an outside wall, which is also parallel to Greenock Bank, and filling the space between it and the present piers with earth. The stones in the outside walls of the old piers will be of considerable use in forming some of the new works, and will occasion a saving for which I have made no allowance, because in every work of this kind there are accidents and expenses which can seldom be foreseen, and therefore the amount of this saving will probably be expended in such unforeseen matters.

I have also shown that an enlargement may be made in the present harbour, by forming the inside of the north piers parallel to those of the outside; but were this even done, although it would be a considerable improvement to the harbour, yet I think the expense would be greater than the advantage gained by it: I therefore do not advise its being done, nor have I made any estimate for it.

The quantity of earth, wanted to fill the spaces between these walls and the piers, will be about 70,000 cubic yards, which must be got from some other place, the same as the new harbour.

The expense of the works for the new harbour, as per estimate, No. I., amounts to	£35,392
For enlarging the east quay of the present harbour, and what is called the new quay, as per estimate No. II.	8,444
And for the western quay, and to Mr. Scott's basin pier, as per estimate No. III.	14,731
	£58,567

This appears to be a larger sum than the gentlemen of Greenock may have been led to imagine, but I doubt that it will be done at less than is here stated, for as all these outer walls must be laid considerably

APPENDIX C.

GREENOCK.

No. 372.
Rennie, on proposed Wet-Docks at Bay of Quick.

under low water, that can only be done with certainty by caissons, which are very expensive, and they must be of large dimensions to resist the action of the sea. I have therefore given such dimensions as appears to me public works of this sort ought to have. When they are done slightly they are in constant want of repair, and very inconvenient in their use while such repairs are in hand.

I have now stated the general outlines of what appears to me proper to be done in the enlargement of the new harbour, and quays of the old, which will more fully appear by inspecting the plans and sections.

In the Bay of Quick I propose a tide harbour, to be constructed with piers of a polygonal form, extending from either side of the bay, and leaving an opening between them of 50 yards wide as an entrance to the harbour; these piers enclose about 11 statute acres, a considerable part of which is dry at low water, but this will be of great benefit, as the flat shelving beach has a greater effect in counteracting the swells of the sea than deep water, and as there will be 21 feet depth of water in the outer part of the harbour, at high water spring tides, it will be found sufficient for any vessel which can with convenience and safety navigate so far up the Clyde; the shelving beach has also another material use, namely, that of stopping a ship's way when she enters in blowing weather. The piers are proposed to be 40 feet broad at the top, and built in the same manner as those in the eastern harbour, but as the water is deeper, and as they are more exposed to the sea, they must be proportionally stronger. On each pier-head at the entrance I propose to fix a capstan with proper tackle to assist vessels in coming into, and going out of, the harbour; and warping buoys, or dead-men, should be placed farther out, to warp them into the channel in northerly winds.

On either side of the harbour I propose to construct a wet-dock, partly on the sea and partly inland, each having an entrance from the dry harbour by a lock 36 or 38 feet wide, and 160 feet long; these locks to enter at the inner angle of the second cant of each pier.

The wet docks are to be filled with water by the tide, and to be dug to the depth of 18 feet under the high water of a spring tide; in the sluices of the locks draw-gates are to be placed, which being opened at low water, will scour both the entrances to the docks and the mouth of the harbour. Sluices may also be placed farther up, to clear away any depositions of mud or sleech which may take place.

The dock on the eastern side I propose to be 242 yards long, and 800 yards wide, which will enclose 5 statute acres; that on the western side I propose to be 400 yards long and 100 yards wide, making an extent of somewhat more than 8½ acres; these docks will therefore accommodate 120 square-rigged vessels of about 200 tons each. The quays on the north side I propose to be formed by a sea wall, extending from the piers of the dry harbour, on each side, in an inclined direction to the great bank, so that the entrance to the ship channel formed by these walls on the one side, and the western end of the great bank on the other, will be a frustum of a triangle, which will give a free entrance to the making tide, and thereby rather facilitate than obstruct the upward current; it is true the piers of the dry harbour extending beyond these will be some obstacle, but the form I have given them will render this obstruction as small as the nature of such a work will admit.

The space between the sea and the dock is 100 feet, and the earth and rubble stone, which are excavated in forming the docks will be applied to filling the space round the docks and harbour.

Thus a quay of 100 feet wide will be formed on the north and south sides of the docks and at the end farthest from the dry harbour, but those next it must be 193 feet to allow sufficient room for the locks. Sections of these are represented in the sections corresponding to the letters in the plan, but when the works come to be executed, plans and sections will be made on a larger scale: the present however are sufficient to show the general design.

From the eastern end of the sea wall of the eastern dock, another wall is proposed to be built in a direction leading to the sea wall of the old harbour, which terminates at the western end of Mr. Scott's basin wall; but leaving an opening of 50 yards wide between them, and within this a small basin is proposed to be made, with two dry docks: this basin will hold such ships as may be going into the dry docks to be graved or repaired, and there will be sufficient room round these docks to lay timber and other materials requisite for the purpose. There is a space of 200 yards in length between the dry docks and the quay wall at the eastern end of the eastern wet dock, which will answer for building ships; so that the business of building and repairing vessels will be contiguous, and very convenient for the general business, which ought to be carried on for the accommodation of the extensive shipping of the port of Greenock.

I am aware that considerable objections will arise to this plan, on account of its interference with private property; but if private property is to stand in the way of so great an improvement, there is an end to every good plan that can be proposed, and I am not aware that any plan could be found possessing the requisite convenience and regularity which could interfere less with the private property of individuals than what is here laid down; which, if carried into execution, will in my opinion, render Greenock one of the completest harbours in the United Kingdom; and I am satisfied that those who have property in this situation, and which is not wholly used for the purpose of the docks, and particularly so large a proprietor as Sir John Shaw Stewart, will find it their interest to give up a part for the improvement of the remainder.

The plan I have here stated will cost, agreeably to the estimates as under, namely :—

For basin, dry docks, and ground for ship building, as per estimate No. IV.	£25,710
Eastern pier and dock, as per No. V.	40,862
Western pier and dock, as per No. VI.	55,402
	£121,974

The above sum is only about twice the amount of the works proposed for the new eastern, and improvements of the old harbour; but whoever will compare the extent of accommodation obtained, will perceive that the difference of expense bears no proportion to the difference of accommodation; and therefore the expense, although very great, is not an object of so much magnitude, when compared to the extent of harbour, as might be imagined: and when it is considered that the plan may be progressively executed, and that each part will afford a proportional accommodation to the trade, I apprehend that even those who are not so sanguine as I may be, need not despair of the whole being done sooner or later.

It appears that, including the masonry wanted for the piers, and earth for filling between sea and dock walls, there will be wanted above 100,000 cubic yards to fill the whole space round the docks and between the pier walls; but as a considerable quantity of earth will be got by levelling the ground on

APPENDIX C.

GREENOCK

No. 372.
Rennie, on proposed Wet-Docks at Bay of Quick.

the south side of the docks for the quays, and from the foundations of the warehouses and other buildings which will be erected as the works of the harbour are extended, which may all be used for filling up the spaces between the walls, there will be a sufficient quantity for this purpose.

It would have been a considerable advantage could the sea wall have been placed farther from the dock wall than that in my plan, so as to have had 160 or 170 feet in breadth on the north side of the docks, because in this case there would have been room for both the wharfs and for warehouses; but this could not have been done without a very great additional expense, as the water deepens very quickly. The warehouses will therefore be confined to the south side, and the two extreme ends of the docks, and the wharf on the north sides, will, I apprehend, be used for iron, and such other articles as will not require to be housed: or the quay might be narrowed to 50 feet, which would admit of a row of warehouses 50 feet deep: this however will be best determined in the use of the docks.

Thus, Gentlemen, have I pointed out what appears to me the best plan for the present and future improvements of the port of Greenock—a plan which has not been formed without much consideration.

That it is perfect I will not pretend to say—perfection does not belong to mortals; but I flatter myself you will find sufficient in it to demand your attention: and I doubt not you will give it that candid consideration the importance of the subject requires, and appreciate its merits accordingly.

I am, &c,
JOHN RENNIE.

To Walter Ritchie and Hugh Crawfurd, Esqrs.

No. 373.

Letter from Mr. THOM, *of 28th April,* 1835, *containing Estimate of the Docks mentioned in* Mr. TELFORD'S *Plan.*

No. 373.
Thom's Estimate of Telford's proposed Docks.

SIR,

Rothesay, April 28, 1835.

I BEG most earnestly to apologise for my long delay (and seeming neglect) in reporting on the relative cost of your dock. It would take much time (and be of little use) to explain at length the numerous and vexatious incidents that came in my way to prevent it; and therefore only beg you all to believe that they proceeded from causes which I could not control—for no one amongst you could be more anxious and earnest about it than myself. It has, however, been delayed for some days past in the expectation of my coming up to explain every thing to you on the spot; but finding it may yet be some days ere I can accomplish this, I now proceed to state what appears to me to be the probable relative cost of the two docks, *as laid down on the plan by Mr. Telford, his* data being applied to *each*, with all the discernment and impartiality I am master of, viz.;—

The east dock, as stated in Mr. Telford's estimate, is to cost 48,550*l.* 8*s.* 10*d.*; but upon a very careful perusal of Mr. Telford's specification, calculations and estimate, I find that he (or rather some one else he has trusted) has made several *omissions* in his estimate, which, when supplied, raise the cost of the east dock to something above 50,000*l.* I find, by applying precisely the same data, that the west dock will cost something above 66,000*l.*; being 16,000*l.* more than the east dock is estimated to cost.

I have gone over the whole repeatedly, and considered every circumstance applicable to each case with the greatest care; a detailed statement of which I will lay before the Gentlemen concerned when I come up in a few days. [It is to be observed, however, that Mr. Telford has laid down his outer sea wall of the west dock farther into the river than the soundings were taken by us; and that, therefore, additional soundings must be taken *exactly* on the *site* of *that* wall, before its height (or depth) can be accurately estimated—as, however, there are soundings laid down at no great distance from the site of that wall on both sides, it is not probable that the result, when the new soundings are taken, will make above 1,000*l.* of difference in its cost: this I stated to Mr. Hamilton when here; and these soundings ought now to be made, and may be done in a short time in calm weather.] But, except as to this particular, you may rely upon the accuracy of the *relative* cost of the two docks, and act accordingly. As to whether it may be expedient to make any alteration on *either* of the plans, it is altogether a different question; but which I have also carefully considered, and will explain if necessary; but I must just state, in the mean time, that the authority of Mr. Telford should not be set aside on light grounds.

The omissions above referred to have no doubt been the omissions of the person entrusted to make out the *details*; and considering Mr. Telford's time of life and the *then* state of his health, it is not wonderful that he should have trusted such details to another.

You will observe, as stated above, that my calculations are founded strictly on Mr. Telford's data as very clearly exhibited in his specifications, and are applied to the two plans exactly as these plans are laid down by Mr. Telford, and explained by *his* specifications. These plans are distinctly shown on the lithographic copy you have passed you. If I have taken much time, I hope I have done the business well at last; for I have certainly been at very great pains with it, and now consider myself as much at home in it as in the Shaw's Water scheme; and shall in future be able to answer any pertinent question respecting it without difficulty or delay. In the mean time I shall be glad to hear that you have received this, and am, &c.

To Andrew Anderson, Esq., Banker, Greenock.

R. THOM.

P.S. There is something original, or new at least, in Mr. Telford's plan of erecting the piers; and this induced me to be at great pains in the investigation, in order to satisfy myself of its practicability, and substantiality or durability; and the result is a full conviction in its favour.

R. T.

No. 374.

Letter from JOHN SHAW STEWART, *Esq., offering Ground for Docks.*

No. 374. Stewart offering ground for Docks.

MY DEAR SIR, *Greenock, June* 24, 1835.

IN reference to what passed to-day at the interview which I had with the Harbour Trustees, I now, on the part of Sir Michael Shaw Stewart, make offer to them of the ground to the eastward of the East Harbour, and situated between the street and low water mark, belonging to him, on the following terms, viz.:—For the first two years, no feu duty to be paid; for the next eight years, the feu duty to be at the rate of five shillings per fall,—after which time, the feu duty to be at the rate of ten shillings per fall,—but this latter rise to take place only provided the amount of the gross revenue drawn from the harbours of Greenock, on the footing of the present rates, during the last three years of the said term of eight years, be at least equal to the amount of the same, during the three years immediately preceding the date of the contract, which may follow on this offer; but if these be found not to be equal, then the said rise shall not take place until the gross revenue in three consecutive years, shall be equal to that amount. The Trustees are to settle all claims of damages competent to the present occupants of the ground. The buildings and materials which are at present the property of Sir Michael are to remain his property, and may be sold by him.

With regard to the ground for the proposed western harbour, I hereby offer the ground belonging to Sir Michael Shaw Stewart, lying between Clyde Street and Low Water Mark, at the rate of two shillings per fall,—no feu duty being to be paid for it during the first two years. The Trustees having liberty in both cases to extend beyond the Low Water Mark, without paying any additional feu duty.

In order to enable the Trustees to make any necessary arrangements with other parties, this offer shall remain in force for twelve months from this date.

I remain, &c.,

To the Honourable the Provost of Greenock. J. SHAW STEWART.

No. 375.

Report of the Committee on the Harbours.

July 6, 1835.

No. 375. Report of the Harbours Committee.

IN entering upon the discharge of their duties, the attention of the Committee was first directed to the inconvenience resulting from the accumulation of timber in the harbours In order to remedy this evil, the depot at Inchgreen has been fenced in, according to the plan which was some time ago submitted to the Council, and now affords accommodation sufficient to warrant the enforcement of the regulation, that all timber be removed from the harbour immediately on its being discharged.

The necessity for more effectual measures to deepen and cleanse the harbours, came next to be considered. It was the opinion of the Committee, that for these purposes a steam dredging-machine should be put in operation, and they expected to have procured one on hire for this season. In this expectation they have been disappointed, and they have it now in view to contract for one, to be ready for working next spring. Before doing so, however, they wish to procure some further information as to the power and dimensions of the machine that will be most suitable.

Patent screw moorings have been placed at the entrance of each harbour, and it is hoped will be found useful.

The alterations that were recommended on the large crane at the east harbour, have been ordered to be made as soon as convenient; and to facilitate the shipment of heavy packages in steam boats, a small crane that will carry six tons has been contracted for, to be erected on the Custom-house quay.

In order to secure one or two additional berths for steam-boats, the recess for the stair on the outside of the east arm of the Custom-house quay, has been ordered to be filled up.

These, with other minor matters connected with the management of the harbours, have had, from time to time, the attention of the Committee; but the most important inquiry in which they have been engaged relates to the demand for additional harbour accommodation, and the cost at which such demand can be supplied. On this subject the Committee believe it to be the general impression, that in any plan which may hereafter be adopted for extending the harbours, it would be extremely desirable to include a wet dock; they have, therefore, endeavoured to obtain information in regard to the expense at which such improvement may be effected.

The first plan of wet docks for the harbour of Greenock was furnished by Mr. Rennie in the year 1802. That plan has been lost or mislaid, but from the report which accompanied it, and which is now in the hands of the Council, it appears that Mr. Rennie proposed to form a tide harbour at the Bay of Quick, and to connect therewith two docks, the one inclosing about five acres, the other about eight acres, with 18 feet of water at spring tides, and, together, capable of containing about 120 vessels of 200 tons burthen. From these docks it was proposed to run a sea-wall eastward to the Westburn, and within that space to have two graving docks, and accommodation for building-yards, &c. The expense of these works was estimated by Mr. Rennie thus:—

Basin, dry docks, and ground for ship-building	£.25,710
Eastern pier and dock	40,862
Western pier and dock	55,402
In all	£.121,974

So that the tide harbour and the two wet docks, exclusive of the other works, and exclusive of the price of ground, &c., were estimated at 96,264

The great expense of the works contemplated by the plan in question, and still more, the inconvenient distance of the Bay of Quick from the present harbours, induced the Committee to direct their attention exclusively to the only other plan of wet docks which the trustees have procured, namely, that furnished by Mr. Telford in the year 1830.—This plan comprehends a dock to the eastward, of about nine acres,

APPENDIX C.

GREENOCK.

No. 375.
Report of the Harbours Committee.

which would enter from, and include part of, the present East India Harbour, and would extend from thence to Mr. Steele's building yard; also a dock to the westward, of about eight acres, to enter from a basin to be formed between the Westburn and the Ropewalk Quay, and to extend westward from that quay about 1000 feet. Both of these docks would have about 20 feet depth of water at spring tides, and according to Mr. Telford's report, each dock would have room for about 100 vessels of moderate size, so that either of them would be amply sufficient for the present wants of the trade.

The expense of the eastern dock was estimated by Mr. Telford at 48,550*l*., but Mr. Thom, who was consulted by Mr. Telford when here, and who has since gone over the calculations, estimates the cost at fully	£.50,000
Add for ground to be feued from Sir Michael Shaw Stewart, about 533 falls, which, at 20 years' purchase of the annual rates specified in Sir Michael's offer, would amount to about	3,735
	£.53,735

To this sum there would have to be added the following items, of which the Committee have got no estimate, viz:

Price of a lot of ground belonging to Mr. M'Millan, ship-builder.
Ditto, of a lot belonging to the heirs of the late Mr. M'Bride.
Cost of sheds along the sides of the dock, causewaying, paving, &c.

Mr. Telford did not furnish any estimate for the western dock, but that want has been supplied by Mr. Thom, who has estimated the cost at fully 66,000*l*.

To this sum must be added the price of all the shore ground from the West Burn to the western extremity of the dock, also the expense of sheds, &c. &c.

Sir Michael Shaw Stewart has offered the unfeued portion of the ground for the western dock at the low rate of 2*s*. annually per fall, but it is only a small portion of that ground which is now in his hands; the greater part is already feued, and consists of several distinct properties upon which the Committee are not enabled to put a valuation.

From what has been stated, it appears that, of the two docks in Mr. Telford's plan, the eastern, besides having the advantage of being so much nearer the present harbours, is the one which could be completed at the least expense; but it is perhaps unnecessary to discuss the comparative merits of the different sites, till the Council determine the general question, whether, in the present state and prospects of the Harbour Trust, it would be prudent to enter upon an undertaking of such magnitude and cost.

The principal arguments brought forward in favour of wet docks are,

1st. That the increasing trade of the port requires additional accommodation.

2d. That the quality of the present harbour accommodation is inferior to that which a wet dock would afford.

3d. That the construction of the wet docks at Port-Glasgow renders it in a great degree necessary for this port to provide similar accommodation.

With the view to ascertain the more clearly how far the first of these arguments is well founded, the Committee instructed the harbour-masters to keep journals showing the dates of the applications made to them for loading and discharging berths, and the dates when such applications are complied with. From an inspection of these journals, which were commenced on the 16th day of December last, and have been continued down to the present time, it appears that the inward ships, during that period, have, with very few exceptions, obtained discharging berths without any delay. Vessels entered for loading have occasionally been unable to procure quay berths so soon as wanted, and under such circumstances have been obliged to take in a portion of their cargoes in the second tier; it does not appear, however, that either inward or outward vessels have been subjected to material detention from a want of harbour room, and the Committee have no reason to believe that greater dispatch is afforded at any port in the kingdom than is usually given to ships at this port. Upon the whole, the journals in question do not indicate a pressing demand for additional harbour room; it is, however, to be observed, that they have not been kept long enough to include those months in which the harbours are most apt to be crowded, and when, consequently, the demand for berths is greatest.

With reference to the second argument, namely, the superiority of wet dock accommodation, it has not hitherto been alleged that vessels resorting regularly to this harbour have been less durable than those trading to ports which have the benefit of wet docks; still it must be admitted that such docks do possess great advantages, especially for the large class of ships, and that it would be most desirable to have such accommodation, if to be attained at an expense which can be prudently ventured upon.

The improvements in progress at Port-Glasgow should, no doubt, operate as a stimulus to our entering upon similar works here; on the other hand, the uncertainty that at present exists as to the extent to which the navigation to Glasgow may be improved, and consequently as to the share of the foreign trade of the Clyde that will ultimately go direct to that port, would seem to call for much caution in incurring an expenditure which would greatly increase the debt of our Harbour Trust.

It is due to Sir Michael Shaw Stewart to state that, taking into view the amount of rent at present drawn for the ground of which he has made offer to the Trustees, the terms of that offer appear to the Committee to be very liberal, and show that Sir Michael is desirous to promote whatever extension of the harbour the trustees may think proper.

The following documents, which were entrusted to the Committee, and which are referred to in this report, are delivered herewith, viz.:—

Report of Mr. Rennie, dated in 1802.
Plan and report of Mr. Telford, in 1830.
Letter from Mr. Thom, of 28th April, 1835,—containing estimate of the docks in Mr. Telford's plan.
Letter from John Shaw Stewart, Esq., of 24th June, 1835, offering ground for docks.

JAMES STEWART, *Chairman*.

APPENDIX C.

GREENOCK.

No. 376.
Committee's Report on want of Harbour accommodation.

No. 376.

Report by the Committee appointed to inquire into the necessity of additional Harbour accommodation.

EXTRACT from the minutes of a meeting of the Trustees of the Harbours of Greenock, held upon the 17th day of November, 1840.

"The subject of harbour accommodation was then taken up, when, on the motion of the provost, it was unanimously resolved, That a Committee be appointed to consider and report upon the following questions, viz.:—

"1. The description and extent of additional harbour accommodation requisite to meet the demands of the increasing trade of the port.

"2. The most eligible site or sites for such accommodation.

"3. The measures most proper to be adopted for providing the same.

"The following gentlemen were appointed the Committee, viz.:—The Provost, Baillies Lindsay and Denniston, Treasurer Gray, Messrs. Sinclair, Steele, Weir, Scott, and Tasker—three to be a quorum. The provost to be convener."

Extracted from the Minutes by
JOHN K. GRAY, *Town-Clerk.*

Greenock, January 2, 1841.

The first question upon which the Committee have to report relates to "the description and extent of additional harbour accommodation requisite to meet the demands of the increasing trade of this port."

In entering upon this question, it is proper to advert to the chief causes of the inconvenience experienced under the existing amount of accommodation. These are—

1st. A deficiency of berthage for both sailing vessels and steamers, particularly those of a large size.

2nd. The accumulation within the harbour of floating timber discharged from the North American ships.

3rd. The incumbrance of the quays and breasts, with timber, deals, staves, &c.

4th. The want of slips to facilitate the landing of heavy timber.

To remedy these inconveniences, various plans have been suggested. The Committee will now briefly notice these plans, and will afterwards submit their views upon each in succession.

For a deficiency of berthage, the remedy which is most obvious, and has been most generally contemplated, is an extension of the harbour by the construction of either a wet dock or a new tide harbour. Another proposal which has been brought forward, and has attracted considerable attention, is to form a breakwater on the sand bank in front of the harbours. Such breakwater, it is alleged, would not only shelter the harbours, but would also make the roadstead available for the discharge of the timber ships, whereby the berthage now allotted to them could be appropriated to other vessels, and the harbours kept entirely clear of floating timber.

To prevent the accumulation of timber within the harbour, the breakwater just mentioned is one of the plans which have been suggested. Another is the construction of a timber pond in Cartsdyke Bay.

The encumbrance of the quays with timber, deals, &c., arises partly from the want of public and private depôts for the reception of such materials, and partly from the aversion of the importers to incur the expense of two removals—the one previous, the other subsequent, to a sale. To remedy this evil, it is plain the trustees must either provide depôts, or throw that burden upon the owners, by enforcing the removal of the property within a reasonable time.

From the want of slips for the discharge of timber, the only remedy that can be suggested is, that such accommodation be provided either in the present harbours or in any new harbour that may be formed.

It has been further suggested, that, independent of those plans of permanent improvement which may be adopted, a considerable amount of temporary accommodation might be speedily obtained by the construction of a wooden wharf or platform, of 30 feet wide, along the outside of the sea-wall of the East India Harbour, whereby that wall would in effect be widened 30 feet. Close to such platform, it is supposed that, by the aid of a steam dredging-machine, a depth of about 12 feet at low water of spring tides could be obtained, and that the whole length of the outside of the East India Quay, now almost useless as berthage, would thereby be made fit to accommodate steamers of the largest class. It is to be observed, that dredging close to the quay, as it stands, cannot be attempted without endangering the foundation; but, at the proposed distance of 30 feet, no risk of that nature is apprehended. In connexion with this improvement, it has been proposed that the trustees should lay branch rails from the same quay by Delinghurn Street to the main line of railway, to facilitate the conveyance of goods to and from the steamers.

Another proposal for temporary accommodation is, to form a wooden jetty, projecting into the east harbour, from near the termination of Virginia-street, for the purpose of affording additional berthage to large steamers while being fitted out.

The Committee having thus brought under view the inconveniences at present experienced by the trade, in regard to harbour accommodation, and having adverted to the plans which have been suggested for remedying the same, will now proceed to submit their views upon these plans, in the order in which they have been enumerated, viz.:—

Harbour extensions.
Breakwater on the Bank.
Timber-pond in Cartsdyke Bay.
Depôts on shore for timber, deals, &c.
Slip for landing timber.
Platform and rails at east harbour.
Wooden jetty near Virginia-street.

Harbour Extension.—A condensed view of the plans and estimates of harbour extension which from time to time have been obtained, is annexed hereto. The question now to be considered is, whether a wet dock or a tide harbour is the more suitable to the present circumstances of this port. The superiority of a wet dock in allowing the ships therein to be kept always afloat, and in affording the

APPENDIX C.

GREENOCK.

No. 376.
Committee's Report on want of Harbour accommodation.

whole of its area instead of the mere range of the quays, for the reception of shipping, is plain and indisputable. On the other hand, the limited range of tide at this port is an objection to the formation of docks here, which does not apply to Liverpool and various other ports where such accommodation has been provided; for, with a rise and fall of tide seldom exceeding 10 feet, the gates of the dock must be always about two thirds under water; consequently the repair of the works, when, from accident or decay, repairs become necessary, must be difficult and expensive, and may at times be be impracticable, without having recourse to the construction of a coffer dam. The same cause, namely the limited range of tide, lessens in another respect the advantage of a wet dock as compared with a tide harbour; for, assuming the latter to have, as proposed by the plans of Messrs. Hamilton and Allison, a depth of 24 feet at high water, it will not even at low water have less than about 14 feet; consequently the vessels therein will at all times of the tide be so far water-borne, that, with ordinary care and attention, they can scarcely incur the smallest risk of damage. It is further to be kept in view, that the harbour-room to be allotted to steamers should, if possible, be accessible to such vessels at all times of the tides, as their arrangements do not admit of delay. Now, a tide harbour of about 14 feet at low water would afford such accommodation to steamers of the largest class; whereas a wet dock cannot be entered or departed from, unless at or near the time of high water. This is an important consideration as regards the accommodation of steamers. A tide harbour is besides much less costly than a wet dock, and would not involve any increase of the existing harbour rates. It could also be constructed in less time, a consideration of some importance in the present circumstances of this port. Taking all these points into view, the Committee are of opinion that, to meet the present wants of the trade, a tide harbour, of a depth of water of 24 feet, or as near thereto as practicable, ought to be preferred to a wet dock It may be here observed, that whatever depth of water can be had for a wet dock, the same can be had for a tide harbour; and that neither for the one nor the other can the requisite depth be obtained, otherwise than by excavation within the dock or harbour, and by dredging outside, to form an approach from the channel of the river.

The Committee, in thus recommending a tide harbour as the most suitable at the present time, would also recommend that the Trustees should keep in view the expediency of purchasing, if they can, on reasonable terms, such shore ground as may seem most suitable for docks, that they may have it in their power to form such accommodation, when an extension of trade shall render it desirable.

Breakwater.—The plan of a breakwater on the bank was furnished in the year 1838, by Mr. James Thomson, civil engineer.

Mr. Thomson proposes that such breakwater, raised to the height of about 17 feet above low water, should run in a parallel line with the harbours, and at a distance therefrom of about 350 yards, from near the tail of the bank on the west to a point opposite Mr. Duncan's building-yard on the east,—and that from that point a half-tide dyke, of the height of 6 feet above low water, should be continued eastward to a short distance above the Channel, called the Throughlet, near Garvel Point, thereby crossing and shutting up that channel. These works, Mr. Thomson conceives, would not only shelter the harbour and roadstead, rendering the latter available for the discharge of timber cargoes, but would also, by confining the current of the river, increase its scouring power, and more effectually prevent the deposit of alluvial matter in the navigable channel.

	£	s.	d.
Mr. Thomson estimates the expense of the breakwater at .	18,261	0	0
Half-tide dyke	4,934	0	0
	£23,195	0	0

On the north side of the breakwater, and adjoining thereto, Mr. Thomson proposes to form a timber-pond or ponds, of nearly 60 acres in extent, into which the timber, as discharged from ships anchored in the stream, could be directly conveyed. The additional cost of these ponds would be very small, as the fences would consist for the most part of wooden stakes.

On inspection of Mr. Thomson's plan it will be seen that the proposed breakwater, though it would still leave the harbours and roadstead exposed in a considerable degree to the N.W. wind, would afford them ample protection from the winds between N.N.W. and E.N.E., from which they are at present most apt to suffer,—and in this particular its effect would be highly advantageous. It does not, however, appear to the Committee that it would afford to the timber trade that accommodation which might at first sight be expected. It must be kept in view, that if the timber ships are to be discharged in the stream, they must be placed in that portion of the channel where there is depth of water sufficient to keep them always afloat; for, though such ships may with perfect safety be allowed to take the ground within the harbour where they have the support of the quays, they cannot, without great risk of damage, be allowed to do so where they have not such support. But it is only in the deepest part of the channel that they can be kept afloat at all times of the tide. They would thus have to be placed at a distance of more than 200 yards from the breakwater, and across that space the timber would have to be conveyed, either in single logs as discharged from the ship, or in rafts formed in the stream. The conveyance in single logs across so wide a space would be tedious and expensive; and to form rafts in the stream would be a work of difficulty, owing to the rapidity of the current. Besides, the continual process of towing timber directly across so large a portion of the navigable channel would, in all probability, be much complained of as an obstruction to vessels passing up and down the river. This last inconvenience would be particularly felt if six or eight ships should happen to be discharging at the same time, as is not unfrequently the case. It may be granted that the channel, by means of dredging, might be deepened, so as to admit of floating the ships somewhat nearer to the line of breakwater; but to bring them within a convenient discharging distance of that line, would require dredging to an extent which, if practicable, would be the work of a very long time, and very great expense. This is manifest from the consideration, that even at the distance of 200 yards from the line in question, the low water depth is only 9 feet; whereas, to keep the ships afloat, a depth of 21 feet at the least would be requisite. Another inconvenience which would attend the proposed mode of discharge is, that the small stowage, viz.: deals, staves, &c., which must be taken out from time to time, while the discharge of the large timber is in progress, would have to be sent on shore on floats, at considerable trouble and expense. There is besides reason to apprehend, that in severe winter-gales the anchorage in the stream, with all its shelter, would not be perfectly secure, and it would be with great reluctance that the owners and masters of ships paying full harbour-dues would consent to accept such accommodation. But supposing that all the objections which have been now stated could be set aside, that the ships could discharge in the stream, and the harbour be kept entirely clear of floating timber, it would still be necessary to provide harbour room for the reception of the ships when discharged. It would therefore seem to the Committee, that the formation

APPENDIX C.

GREENOCK.

No. 376.
Committee's Report on want of Harbour accommodation.

of the breakwater would not supersede the necessity for extension of the harbour in some shape or other. Such being the views of the Committee, they would recommend that harbour extension should be proceeded with first, as being the improvement most urgently called for, and its advantages to all branches of the trade being plain and indisputable, and that the plan of the breakwater or other works on the bank should be more maturely considered, before any determination be formed in regard thereto.

Timber pond in Cartsdyke Bay.—On this point the first inquiry is, what would be the cost of such improvement. Messrs. Hamilton and Allison estimate the expense of the protecting-wall at 7,200*l.*, to which sum there would have to be added the price of the whole of the shore-ground between Cartsdyke Burn on the west, and the Bottlework quay on the east. According to the view of the Committee, therefore, the total expense cannot safely be estimated at less than 25,000*l.* It remains to inquire whether the benefit to result from the improvement would be in proportion to such outlay. The timber-ponds in use at Inchgreen are more extensive, and not less secure than the proposed pond at Cartsdyke would be. The former measure about 18 acres; and though at the present moment fully occupied, have heretofore been found sufficient for the trade. The latter would measure about 12 acres. The pond at Cartsdyke would not supersede the necessity of discharging the timber ships in the harbour as at present. It would merely serve as a depôt for the reception of the timber when brought from the harbour, just as Inchgreen does. The only argument, therefore, which can be urged in favour of the improvement is, that Cartsdyke Bay being so much nearer, the timber could be taken there with more regularity, and at less expense than to Inchgreen. In this argument it does not appear to the Committee that there is much weight. It is true that in point of facility and regularity of removal, the nearer depôt would in stormy weather have some advantage; but the gain in that particular could not be very great; and in point of expense. supposing tug steamers to be employed, all the difference in favour of the Cartsdyke station would be the saving of one mile of towage. Such being the views of the Committee, they cannot recommend the formation of a timber-pond in Cartsdyke Bay; but in order to meet the increasing demands of the timber trade, they would recommend that application be made for a lease of a portion of the shore between Garvel Point and Inchgreen, to be enclosed and used as additional timber ponds, if on inspection it be found suitable for such purpose.

In connection with this question, the Committee would beg to observe, that in their opinion the accumulation of timber in the harbour might be greatly diminished if the trade were to adopt a more efficient system for removing the timber regularly from day to day, when the weather permits, by means of tug steamers. The expense of such arrangement, as compared with the present mode, could not be very burdensome. The charge per hour for a steamer so employed is one guinea—a trip to Inchgreen can be easily made within the hour, and it is presumed that 100 tons of timber could be taken up at one trip—the expense, therefore, of towage from the harbour to Inchgreen would be one guinea per 100 tons timber; but supposing it to be considerably more, it cannot be such as to form a sufficient apology for delay in removing the timber.

The Committee, although they consider it inexpedient to make the proposed improvement in Cartsdyke Bay under present circumstances, would nevertheless recommend that the Trustees should endeavour to obtain power in their next Harbour Bill to provide additional accommodation in that locality if they see proper.

Depôts on shore for Timber, Deals, Staves, &c.—With the view of accommodating the trade as far as possible in this particular, the Committee would recommend that the enclosures belonging to the Trustees at the east and west harbours, which have hitherto been let as bonded yards and for other purposes, should in future be reserved for the reception of timber, deals, &c., at such reasonable rates of rent as may hereafter be determined; and as the accommodation thereby obtained will not be sufficiently extensive, they would further recommend that endeavours be used to procure by purchase, or on lease, some additional ground near the harbour, to be appropriated to the same purposes, particularly for the reception of heavy timber, with which the quays have been of late very much encumbered.

Slip for the Discharge of heavy Timber.—The Committee are of opinion that such accommodation is very much wanted, and ought to be included in whatever plan of harbour extension may now be adopted; but they are not prepared to point out any site where it could be conveniently provided within the present harbours.

Platform or Wharf along the outer face of the East India Quay.—According to the best information which the Committee have obtained, the cost of this improvement would not exceed 2,600*l.*; and as its effect would be to make the whole of the outer side of the quay in question available as berthage for large steamers or other vessels, the Committee are of opinion that it ought to be undertaken with as little delay as possible. It is to be observed, that in carrying into effect this improvement, the additional expense of a steam dredging-machine will have to be incurred; but such machine must be got at any rate if harbour extension in any shape is to be proceeded with.

Branch rails on East India Quay.—The expense of such rails is estimated at about 750*l.*, and it is the opinion of the Committee that it would be for the interest of the Trust to submit to that expense with the view of thereby promoting an extension of harbour business in connection with the railway.

Jetty at the termination of Virginia-street.—It appears to the Committee a matter of doubt whether such jetty would not be found an obstruction in the harbour, even if the floating timber could be got rid of; but, at all events, until that object can be accomplished by means of harbour extension or otherwise, they would not recommend such work.

The Committee having thus explained their views in regard to the description of additional accommodation which seems to them to be called for, have now to offer their opinion as to the extent of the proposed tide harbour.

A harbour of less area than from 4 to 5 acres, which is about the extent of the present East India harbour, would be found too confined for the proper accommodation of ships of large size. It would not therefore be advisable to form one of smaller capacity, and the Committee would not recommend a larger, because a harbour of such extent will in their opinion be sufficient to meet the wants of the trade for some time to come, and will besides, with the other improvements in view, cost as much as it would perhaps be prudent for the Trust to expend under present circumstances. Judging from the estimates referred to in the Appendix, the least sum for which such a harbour can be formed will be 40,000*l.*, exclusive of the price of the ground, and independent of the expenditure that will be requisite for the proposed improvements of the East India Quay.

The next subject of inquiry is,

The most eligible site for the proposed Tide Harbour.—The two sites which have been suggested to the eastward of the present harbour are Cartsdyke Bay, and the space between the east harbour and Mr.

APPENDIX C

GREENOCK.

No. 376.
Committee's Report on want of Harbour accommodation.

Steele's yard. The plan which has been proposed by Messrs. Hamilton and Allison for Cartsdyke Bay, as will be seen by the Appendix, is upon a scale exceeding in extent and expenditure what the Committee are disposed to recommend. The proposed extent is 12 acres, estimate 58,900*l.*; but supposing that by limiting the extent to about 5 acres the expense of such harbour could be reduced to an equality with the expense of one of the same extent adjoining Mr. Steele's yard, the Committee would still prefer the latter site; because, while it is as easy of access from the water, it is more accessible from the land, and is further recommended by its proximity to the present harbours, to the railway, to warehouse accommodation, and to the seat of general business. It is therefore the opinion of the Committee, that the choice of the Trustees should lie between the site adjoining Mr. Steele's yard, and a site to the westward of the West Burn. In point of expense, there is no reason to suppose that for harbours of equal extent the difference between such sites would be very material. Messrs. Hamilton and Allison estimate a harbour of 4½ acres on the east side at 39,022*l.*; and one of 5 acres, west, near Patrick-street, at 42,600*l.* It is therefore by a comparison of the advantages of the respective sites, independent of the question of cost, that the choice of the Trustees will fall to be determined.

The peculiar advantages of the east site have been already noticed, namely, its proximity to the present harbour, the Custom-house, the railway, warehouses, foundries, and other establishments connected with the shipping. These are very strong recommendations. There are, however, some objections to this site. In the first place, the access to it from the river is inconvenient, owing to the narrow limits of the navigable channel in this locality. This objection is of less importance now that vessels are usually taken to and from the harbour by steamers; but still it is deserving of notice. Another objection is, that the ground in the immediate vicinity is already so occupied that there is small probability of finding at hand sufficient space for the reception of timber, deals, &c., the want of such accommodation, as regards the present harbours, being very much felt. A third objection is, that a harbour on this site cannot be connected with, or form a portion of, any more extensive plan of improvement to be executed progressively, and that when further accommodation becomes requisite it will be necessary to go westward, under more disadvantageous circumstances than at present.

In regard to a western site, the main objections are its distance from the railway, the warehouses, &c., and the difficulty of forming a convenient line of street to connect it with the present harbours. These objections do not apply very strongly as regards the ships in the timber trade. The distance from the establishments referred to would not be of much importance to them, neither would the want of more direct communication with the present harbours. And if these ships could be transferred to a new western harbour, the present east harbour would then perhaps afford sufficient accommodation to the steamers connected with the railway, while the other classes of shipping would find berthage in some part or other of the present harbours. The principal objections to sending the timber ships so far west are, the extra towage in taking the timber up the river, and the risk of some inconvenience to the navigation from having to tow the rafts along the whole line of roadstead. Taking into view the inconveniences which have thus been referred to as connected with a western site, it remains for consideration how far such inconveniences may be counterbalanced by the following advantages:—First, that such site is in the direction of the natural progress of the town, which is rapidly extending to the west, and in all probability will continue to do so. Secondly, the greater facility of access to and from the river, in consequence of the greater breadth of the navigable channel; indeed, the site opposite Patrick Street is altogether clear of the Bank. Thirdly, the facility of finding accommodation adjacent to the harbour for lumber of all descriptions, with which the present harbours are so much encumbered. Fourthly, the practicability of connecting any western harbour that may be now formed with plans of farther improvement. Thus the tide harbour of the present day may serve as the entrance basin of the wet docks of a future time, and thereby save the expense which would otherwise be requisite to form such basin. Another consideration in favour of a western site is, that the Trustees have power to form a new harbour in that locality without a new Act of Parliament, provided they can come to terms with the proprietors of the ground required for the purpose. They have not such powers as regards the eastern site. Now, to say nothing of the expense of a new Act, eighteen months at the least must elapse before it can be procured; and it is impossible to say whether unforeseen obstacles may not arise to prevent its being obtained even then. It would therefore be no small advantage to be able to proceed under the existing Harbour Acts.

The Committee having thus brought under view what appear to them the advantages and disadvantages of the respective sites, think it best to leave the selection in the hands of the Trustees without offering here any decided opinion on the question.

The only remaining point upon which the Committee have been directed to report, relates to

The Measures most proper to be adopted for providing the Harbour accommodation deemed requisite.

The nature of the improvements herein recommended indicates, to a certain extent, the steps necessary for carrying such improvements into effect; but the Committee would further recommend that the Trustees should, as soon as convenient, select an engineer who will undertake to superintend the operations in view; and that such engineer be consulted in regard to these operations, and also on the question of site, before a final determination be come to thereupon. The only other suggestion which the Committee have to offer is, that measures be taken as soon as convenient to ascertain on what terms the ground east and west can be procured, as the probable cost of the respective sites will, of course, have some influence with the Trustees in making a selection.

WALTER BAINE, *Convener.*

Mr. Rennie's Plan, 1802.

WEST SITE.	ESTIMATE.
Tide basin at Bay of Quick, 11 acres	£96,264
1 Dock east of the basin, 5 acres	
1 Dock west of ditto, 8½ acres	
Depth of water, 18 feet	

Mr. Telford's Plan, 1830.

WEST SITE.	
Tide basin adjoining the west side of the West Burn, 2 acres	66,000
1 Dock, west of the basin, bounded on the south by Clyde Street, 8 acres	
Depth of water, 20 feet	

APPENDIX C.

GREENOCK.

No. 376.
Committee's Report on want of Harbour accommodation.

EAST SITE.	ESTIMATE.
Tide basin to consist of part of the East Harbour 1 Dock extending east from the basin to Mr. Steele's yard, 9 acres, including 4½ acres of the present East Harbour Depth of water, 20 feet	£50,000

Messrs. Walker and Burges's Plan, 1836.

WEST SITE.	
Tide basin near the termination of Patrick Street, 3 acres 1 Dock running east from the basin to the West Burn, bounded on the south by Clarence Street, 10 acres Depth of water, 22 feet	120,000
Tide basin, same as the preceding, 3 acres 1 dock running west from the basin into the Bay of Quick, 10 acres Depth of water, 22 feet	100,000
EAST SITE.	
Tide basin to consist of part of the East Harbour 1 Dock extending east from the basin to Mr. Steele's yard, 10 acres, including 5½ acres of the present East Harbour Depth of water, 22 feet	80,000

Note.—The greater cost of the docks in this plan, as compared with Mr. Telford's, is ascribed by Messrs. Walker and Burges to the greater extent and depth of their docks, the larger dimensions of their locks, and a more substantial and expensive mode of piling.

Messrs. Hamilton and Allison's Plan, 1840.

EAST SITES.	
Tide Harbour occupying the space between the East Harbour and Mr. Steele's yard, 4½ acres Depth of water, 24 feet	39,022
Wet dock, same site, with entrance from the present East Harbour, 4½ acres Depth of water, 24 feet	65,180
Note.—The expense of deepening the East Harbour to 24 feet is included in this estimate.	
Tide harbour in Cartsdyke Bay, occupying the space between Cartsdyke Burn and the Bottle Work Quay, 12 acres, with a tongue in the centre; the west half of the harbour deepened to 24 feet—the east half to be of its present depth	58,900
Plan for deepening to 24 feet the present East India Harbour, and enlarging it by taking in the space extending to Mr. Steele's yard, with other alterations shown in the plan and report	61,600
WEST SITES.	
Tide harbour near the termination of Patrick Street, 5 acres Depth, 24 feet	42,600
This harbour is placed so as to serve for entrance basin to two wet docks—the one on its east side, 6 acres, the other on its west side, 8 acres. The cost of these docks not estimated.	
Messrs. Hamilton and Allison, in their report, state that a tide harbour, similar in extent, &c., to that proposed for Cartsdyke Bay, could be formed along the line of Mr. Ramsay's ropework for about the same sum	58,900

The Cost of the Ground is not included in any of the preceding Estimates.

No. 377.

Report of JOSEPH LOCKE, Esq., F.R.S., C.E., *in regard to the proposed Improvements of the Harbours.*

No. 377.
Locke, on improving the Harbour.

London, April 23, 1841.

GENTLEMEN,

SINCE I had the honour of addressing to you a preliminary report on the subject of the harbour extension, Mr. Errington has completed the borings, surveys, soundings, &c.; and having given these much consideration, I am enabled to comply with the wishes of the Trustees, expressed in the minutes of their meeting held on the 27th March last.

It appears to be generally admitted that additional room can be afforded either to the east or westward of the present harbour, and it only remains, therefore, to determine at which end it is more desirable to begin.

Viewing this part of the question in reference to the description of shipping which most requires accommodation, the proximity to existing establishments in the town, and the facility of forming a communication with the railway, I am of opinion that the eastern harbour offers the greatest inducements for the first operations. It is unnecessary for me, I presume, to enumerate those establishments, or to point out by what process a communication with the railway could be best made; for the Trustees are, I am sure, sufficiently aware of the importance of that locality, and that it has already been suggested to them to lay down rails on the east quay, into the station ground, intended by the Railway Company for goods, on the side of Delingburn Street. I shall proceed therefore, at once to the description of the plan for forming the eastern harbour.

On the extreme east, adjoining Mr. Steele's yard, I propose to make a quay 80 feet wide, extending to the river as far as the sea-wall, which forms the front of that establishment. I propose, also, to increase the width of the present East India Quay to 80 feet, and to run the river wall in the direction shown on the accompanying plan, so as to unite with the timber platform already agreed upon. The southern wharf wall is set back from the line of the east quay breast, with a view to give greater space to the harbour, and there is still sufficient space between that wharf and Rue-end Street for warehouses or other buildings that may hereafter be required. If, however, in this particular I have encroached on property that is considered too valuable, or that might be better appropriated to other purposes, it will only be necessary to limit the size of the harbour by keeping the southern wall in a line with the East India breast. It is however desirable, when once the expense of a river wall is incurred, to acquire as much space as can with propriety be obtained. The interior of this harbour will cover an extent of 6 acres.

The borings that have been made lead to the conclusion that the foundations of the river walls will be in a stratum of silt, but notwithstanding this, I have not included in the estimate any sum for piles, believing, as I do, that such walls, placed on a good bed of concrete, will be sufficiently substantial. In the event, however, of this silt turning out to be less favourable than I apprehend it to be, by which the difficulty of placing the concrete sufficiently low may be increased, it may be necessary to employ piles, by which the estimate may be slightly augmented. A coffer dam will be requisite from the East India Quay to the junction with Mr. Steele's wall—all the other walls will be put in without the aid of a dam.

The Delingburn, during the operations, will require to be diverted. The easiest mode of doing this will probably be to change its course into the East India Harbour.

The estimated cost of forming the eastern harbour, to the depth of 24 feet below high water, is 55,000*l*. In this is included the timber for the coffer dam, which will be available for other work, and which may be worth about 4000*l*. or 5000*l*.

The western harbour, which I come now to describe, is shown on the general plan, and commences at the West Burn with a quay 120 feet wide. The front quay, which has a direction nearly parallel to the channel of the river, is 70 feet, and the extreme western quay 100 feet wide.

The space between Clarence Street and the southern wall is at the narrowest point 100 feet. The area of the harbour is about 8½ acres, its length being 1000 feet, and its average breadth 375 feet.

With a view to give all the accommodation which, from the great length and expense of the river wall, it becomes desirable to obtain, I have been induced to encroach on the property now used as a rope manufactory, as well as on the properties lying between it and Messrs. Scott's yard. With reference to the latter properties, it is not essential that the harbour should commence close to the West Burn, it may be removed still farther west; but with reference to the ropery, I am of opinion that any harbour on the scale contemplated should include that property. It would be difficult without it to swing a large class steamer in the harbour, which would be so narrow as materially to cripple the necessary operations within it, particularly when vessels are lying at the quays.

The front or river wall will require a coffer dam throughout, and I propose to lay all the walls on a bed of concrete. The estimated cost of this harbour is 80,000*l*.; but should the timber from the eastern coffer dam become available, a saving to the extent of 5000*l*. would be made. Should the Trustees think that this harbour is projected on too large a scale, and that it would be better to reduce it to the same extent as the eastern, I can say that there is no reason why it should not be curtailed if the trade does not require it, and that a proportionate reduction in the expense will be effected by it.

From the nature of the trade carried on in the port of Greenock, it appears that, in connexion with this project, some mode of disposing of timber, when discharged from the ships, must be adopted. With this view, I would beg to suggest that a bank be formed from the material excavated from the harbour, either at Cartsdyke Bay, or close adjoining the extreme western quay, near the Bay of Quick. This bank could, if necessary, be pitched with stone, and raised to any required height, and the interior could also be so excavated as to allow the greatest portion of the timber to be always afloat. The expense of forming these ponds will depend on the extent to which they are carried; but as their estimation is not included in your instructions to me, I have not minutely directed my attention to them. They cannot, however, be very costly, and they should certainly be carried on simultaneously with the harbour to which they be contiguous.

With reference to the question of deepening the present East India Harbour, it is quite clear that, until farther accommodation be given, no operations for that purpose could be admitted; and if the new eastern harbour were made, it would then become a question whether it would be more desirable to expend the funds of the Trustees in deepening that harbour, or proceed with the new works to the west. The practical answer to that question will arise from the results of the eastern harbour, when made.

If it can accommodate the large class vessels, and there should continue to frequent the port vessels of smaller size, it may prove better for the Trustees to expend their funds in works which really give them more room, and more wharfage, rather than in deepening a harbour, which, after all, may not require it: at all events, it may not be necessary to deepen it to such an extent as the others; and if not, it is probable that by driving close sheeting piles, properly tied, a few additional feet in depth could be obtained at a very moderate expense. Whether, however, this may be required or not, I am not prepared to recommend that any measures for deepening this harbour be proceeded with at present.

I have not thought it necessary, at this stage of the proceedings, to prepare detailed drawings of the several works contemplated in the estimate now presented to you, nor do I think it necessary to do so until the time shall arrive when the works are to be contracted for. I shall be glad, however, to furnish you with a more specific description, accompanied with drawings of any portion of the work on which you may require further information.

Although I am not so well acquainted with the trade of the Port of Greenock as are the gentlemen whom I have the honour to address, I have, during my connection with the railway, seen enough of the Clyde to satisfy me, that however great has been the demand for additional harbour accommodation, the time has yet to come when that demand shall reach its maximum. The establishment of the railway will so facilitate the transmission of merchandise as may induce vessels to stop at Greenock instead of proceeding to Glasgow. Paisley, too, must inevitably require its chief port business to be carried on at Greenock; and these circumstances, in addition to the belief that the owners of the deep sea steamers will find it their interest to stop at Greenock, lead me to the conclusion that the time is arrived when further harbour accommodation must absolutely be afforded.

I repeat that the railway will furnish to the port of Greenock a means of transit possessing such advantages as shall command a considerable portion of the trade, and require such an augmentation of harbour accommodation as will include both the eastern and western plans that I have suggested. I am of opinion, too, that these works require only to be constructed to see them in active use; and in

APPENDIX C.

GREENOCK.

No. 377.
Locke, on improving the Harbour.

pressing these views on the Trustees, I trust to be excused for urging that land for both harbours be secured, and that no opportunity be ever lost of acquiring land in any situation where possibly a harbour could be made.

Much more might be said on this subject. It is a very important one for the town of Greenock. Of this, however, I know you are sufficiently sensible, and I shall, therefore, leave it in your hands.

I am, &c.,
JOSEPH LOCKE.

To the Provost and Trustees of the Harbours of Greenock.

This Report was referred to the Harbour Accommodation Committee, appointed at a previous meeting of the Trustees, to "inquire into the description and extent of the additional Harbour accommodation requisite to meet the demands of the increasing trade of the Port."

[For their Report see Evidence, p. .]

No. 378.

Memorial of Deep Sea Pilots.

No. 378.
Memorial of Deep Sea Pilots to the Tidal Harbours Commission.

To the Commissioners of Tidal Harbours. The Memorial of the undersigned Deep Sea Pilots of Greenock.

HUMBLY SHEWETH, *Greenock, November* 24, 1846.

THAT your Memorialists are deep sea pilots, of the port of Greenock, and are at present licensed by a Board nominally consisting of the Dean of Guild of Glasgow, the Provost and Baillies of Greenock, and the Provost and Baillies of Port Glasgow: but for many years past the above-mentioned authorities of Glasgow have not acted.

That your Memorialists labour under peculiar hardships and grievances, especially in comparison with the privileges and protection enjoyed by pilots of other ports, which they beg to bring under your Honours' consideration, with a hope of obtaining immediate redress.

That your Memorialists are obliged, in the prosecution of their arduous calling, to maintain a superior class of pilot vessels, averaging in value from 250*l.* to 300*l.*, with suitable crews, as they are in the practice of going a considerable distance to sea, in order to look out for vessels entaring the Frith of Clyde.

That after the utmost peril and anxiety on the part of the pilots, these vessels, in numerous instances, refuse their services, and that, not unfrequently, to the loss of the owners, underwriters, and others.

That your Memorialists are often exposed to the risk of being carried to sea in vessels outward bound; and this has happened in several instances, to the great loss and injury of their business, and those depending on them for support.

That in consequence of the want of a sufficient surveillance, the river pilots licensed at Glasgow often trench on the rights of the Greenock pilots, by accompanying the vessels from that port far beyond the boundary authorized in their license, while your Memorialists have been subjected to prosecution for accompanying ships from Glasgow, to save boarding them at Greenock, although they had not acted in the capacity of pilots, though fully qualified to do so.

That numerous vessels, both British and foreign, enter and leave port without employing a pilot; thus not only subjecting the property of the owners and other parties interested to the greatest risk and peril, but also the lives of passengers and crew, while your Memorialists are bound to attend when called, either by night or day, to vessels in distress or otherwise, and that under the severest penalties.

Your Memorialists would beg the special attention of your Honours to the fact that in London, Liverpool, and other important ports, and now also in Glasgow, the pilots have privileges not enjoyed by or permitted to your Memorialists, such as the right of boarding ships at sea, for the purpose of conducting them into port, and also of taking them out to sea; and even in the inferior ports of Ardrossan, Troon, &c., vessels of certain burthen coming into or leaving port are bound to pay pilotage, whether pilots have been actually employed or not; the amount of said pilotage being distributed among the several pilots belonging to these ports.

Your Memorialists would humbly submit, that, if speedy redress is not afforded, it will be difficult to find a sufficient number of individuals possessed of the necessary qualifications and capital to supply the necessities of this port, especially in cases of emergency and distress.

That your Memorialists have repeatedly represented, verbally, their grievances to individual members of the Licensing Board, and they have also formally memorialised it as a body, but hitherto without the smallest success.

May it therefore please your Honours to give the case of your Memorialists your most favourable consideration, and direct that such measures may be adopted as will give immediate redress to the grievances stated in the premises, and thus enable them to enjoy the privileges and protection granted to those of the same profession in other ports.

And your Memorialists will ever pray.

DANIEL M'CORMICK.
HUGH TURNER.
WILLIAM HOWESON.
JOHN M'LEAN.
DANIEL SHEE.
WILLIAM CLARK.
JOHN MILLER.
RICHARD ADAMS.
THOMAS SIMPSON.
SAMUEL JAMIESON.
JOHN STEWART.
JAMES CRAWFORD.
WILLIAM ADAMS.
JOHN MC WHIRTER.
PETER MATHEWS.
ALEXANDER MURPHEY
JOHN DEAS.

[The rest of the pilots are out at sea.—J. M.]

APPENDIX C.

GREENOCK.

No. 379.
Statement of Revenue and debt of the Harbours for 1824—46.

No. 379.

Greenock Harbours.

The present GREENOCK HARBOURS were completed in the year 1824, and the Gross Revenue for that and the succeeding years, with the Gross Debt, Available Means, and Net Debt applicable to the present harbours, are stated in the several columns of this sheet.

Date of Balance.	Gross Revenue.	Gross Debt.	Available Means to be deducted from Gross Debt in order to show the Net Debt applicable to Old Harbours.				Net Debt applicable to Old Harbours.
			Money in Banks, &c.	Property purchased with a view to Harbour Extension but which might be sold without injury to the Old Harbours or the New Harbours now in progress.	Property purchased for the site of the New Harbour and payments made to account of its construction.	Total amount of money, property, &c., which fall to be deducted from the Gross Debt in order to show the Net Debt applicable to Old Harbours.	
Sept.	£.	£.	£.	£.	£.	£.	£.
1824	8,901	128,320	8,143	..	..	8,143	120,186
1825	10,419	128,627	9,735	..	..	9,735	118,892
1826	10,869	125,249	9,958	..	..	9,958	115,291
1827	11,542	124,718	10,365	..	..	10,365	114,353
1828	11,664	124,500	12,248	..	..	12,248	112,252
1829	11,024	122,772	12,421	..	..	12,421	110,351
1830	11,162	121,286	13,416	..	..	13,416	107,870
1831	11,754	121,178	16,140	..	..	16,140	105,038
1832	12,662	121,522	19,982	..	..	19,982	101,540
1833	13,231	111,559	13,966	..	..	13,966	97,593
1834	13,907	114,213	20,851	..	..	20,851	93,362
1835	13,808	110,945	22,421	..	..	22,421	88,524
1836	13,984	106,496	22,741	..	..	22,741	83,755
1837	13,553	98,804	20,478	..	..	20,478	78,326
1838	14,210	92,293	20,274	..	..	20,274	72,019
1839	13,960	88,993	22,953	..	..	22,953	66,040
1840	15,833	86,716	25,895	..	..	25,895	60,821
1841	16,953	91,787	31,591	4,049	..	35,640	56,147
1842	14,207	78,131	14,877	5,436	..	20,313	57,818
1843	12,733*	106,821	40,790	5,472	5,005	51,267†	55,554
1844	11,606	109,901	46,150	5,557	5,005	56,712	53,189
1845	14,643	105,903	48,300	5,557	5,005	58,862	47,041
1846	14,400	110,070	40,179	5,557	23,009	68,745	41,325

* In 1843 the dues on shipping were reduced, and that reduction is equal to 1,500*l.* to 2,000*l.* per annum on the total revenue. It is still in operation.

† In 1843 the trustees proceeded to borrow additional sums in order to prepare for the construction of the new harbours.

Extracted from the Books of the GREENOCK HARBOUR TRUST.

Chamberlain's Office, Greenock,
November 23, 1846.

JNO. MARTIN,
Deputy Treasurer for the Trust.

No. 380.
Schedule of Bay Anchorage Dues.

No. 380.

Schedule of Bay Anchorage Dues.

PAYABLE at the following rates by every vessel anchoring in the Roadstead, or between Garvel Point on the east, and White Farland Point on the west, both when going up and coming down the river Clyde.

1 to 9 tons	0*s.* 9*d.*	20 to 49 tons	1*s.* 6*d.*	100 to 124 tons	3*s.* 0*d.*
10 to 14 ..	1*s.* 0*d.*	50 to 74 ..	2*s.* 0*d.*	125 to 149 ..	3*s.* 6*d.*
15 to 19 ..	1*s.* 3*d.*	75 to 99 ..	2*s.* 6*d.*	150 to 199 ..	4*s.* 6*d.*

200 tons 6*s.*, and 1*s.* additional for every 50 tons above 200.

No. 381.

Return of the Income and Expenditure, for the Years 1841–2–3.

INCOME.

Heads of Income.	1841 £.	s.	d.	1842 £.	s.	d.	1813 £.	s.	d.
Dues on tonnage and goods	13,195	3	10	11,208	0	3½	9,816	1	10
Graving dock dues	1,234	2	1	984	18	0	838	11	7
Police dues	1,351	17	4	1,104	17	5½	996	17	10½
Rents, feu duties	1,092	0	4	829	9	0	1,001	0	3
Anchorage, shore, bay, ring, and other petty dues received by the Corporation‡ £.	1,483	0	2	1,241	5	3	1,181	18	4
£.	18,356	3	9	15,368	10	0	13,834	9	10½

EXPENDITURE.

Heads of Expenditure.	1841 £.	s.	d.	1842 £.	s.	d.	1813 £.	s.	d.
Salaries of treasurer, harbour-master, clerk, and master of works	545	17	4	607	11	7	635	5	6
Commission on collecting dues	387	3	1	329	17	5	277	13	7½
Repair and maintenance of works	1,208	11	3	1,116	1	8	1,243	16	5
New works	3,061	19	8	2,132	6	1	242	4	0
Graving dock, engineer, coal, repairs, new engine, &c.	379	19	2	292	19	0	509	10	5
New dredging machine	..			2,872	11	8	*266	9	7
Dredging harbours, including repairs of punts, &c.	530	18	9	50	3	6	645	0	9
Lights on quays	527	14	0	510	9	0	510	9	0
Stamps, stationery, and miscellaneous expenses	213	2	2	129	3	3	469	2	2
Police establishment	1,785	19	0	1,759	11	10	1,787	11	2
Legal and engineering expenses in procuring a new harbour bill	..			3,274	3	5	..		
Legal and engineering expenses in establishing the right of the trustees to construct a breakwater	..			..			698	13	11
Rents, rates and taxes	128	0	9	144	1	9	202	3	11
Interest on the money borrowed	3,430	1	6	2,579	5	7	2,879	16	11
£.	12,199	6	8	15,798	5	9	10,387	17	4½
£.	12,199	6	8	15,798	5	9	10,387	17	4½

* Balance.

† Dues levied by authority of Acts 13 Geo. 3, c. 28; 29 Geo. 3, c. 43; 41 Geo. 3, c. 51; 43 Geo. 3, c. 87; 50 Geo. 3. c. 167; 57 Geo. 3, c. 32; 5 Vict. c. 54.

‡ These dues are levied by virtue of a Charter, and the proceeds are expended upon the general good and improvement of the town of Greenock.

JOHN MARTIN, *Deputy Treasurer and Chamberlain.*

Debt due on the 1st of January, 1846, 57,604*l.*

GOUROCK.

No. 382.

Return to the Order of the House of Commons of August 9, 1844.

GOUROCK.

No 382.
Return to Order of August 9, 1844.

SIR, *Gourock House, March* 12, 1845.

WITH reference to your circular letter of the 14th ultimo, I beg to inform you, that by a charter under the great seal granted by King William and Queen Mary as princes and stewards of Scotland, privilege of a free sea port was granted to the then proprietor of Gourock and his successors, with power to levy all small customs, anchorages, shore dues, and other dues; which charter is dated at Kensington, 24th April, 1694, registered 1st March, 1695, and sealed at Edinburgh the same day, confirmed by Parliament 17th July, 1695, and the same has been confirmed to the present proprietor of Gourock, General Duncan Darroch.

The present pier is within the harbour of Gourock, and was, with consent of General Darroch, the party in right of the harbour as aforesaid, erected by a Joint Stock Company, called "The Gourock Harbour Company," which Company was incorporated by Act of Parliament 5 & 6 William IV. cap. 78, dated 21st July, 1835, entituled "An Act for erecting and maintaining a Pier or Harbour at Gourock, in the County of Renfrew," dated 21st July, 1835. A copy map or plan of the pier is herewith sent, showing the depth of water at high and low water.

No particular report respecting the harbour since its erection has ever been made by any engineer.

The harbour is greatly frequented by the trade of the Clyde.

The pier is used by vessels engaged in the herring and cod fisheries, and by small vessels engaged in white fishing, for exports of dressed paving stones and free stones, and imports of coal, lime, slates, wood, &c. for the use of the village and surrounding country. It is also occasionally used by vessels belonging to Her Majesty employed in the revenue preventive service, and about 20 passenger steamboats touch at it twice each day in summer.

Complaints have been made to the Harbour Trustees of a shoal or bank situated a little to the north-west of the pier. There was a post or beacon put on it, but the same has been as often knocked down as put up, by vessels running foul of it.

I am, &c.,
DUNCAN DARROCH, *Vice Chairman.*

To the Honourable H. Manners Sutton.

No. 383.

Return of the Income and Expenditure for the Years 1842–3–4.

No. 383.
Income and Expenditure.

INCOME.

Heads of Income.	1842 £.	s.	d.	1843 £.	s.	d.	1844 £.	s.	d.
Harbour dues	235	7	11	187	6	3	555	17	6½
Small dues	61	4	11	69	18	1	68	8	7½
Total	296	12	10	257	4	4	624	6	2

EXPENDITURE.

Heads of Expenditure.	1842 £.	s.	d.	1843 £.	s.	d.	1844 £.	s.	d.
Salaries	72	0	0	72	0	0	75	0	0
Repairs	28	14	10	18	6	10	204	18	9
Charges	28	1	5	4	12	3	59	2	9
Interest on money borrowed	105	6	7	133	10	8	148	7	6½
Dividend	..			..			90	0	0
Total	234	2	10	228	9	9	577	9	0½

Dues levied by Royal Charter, dated 1694; confirmed by Parliament 1695.

DUNCAN DARROCH, *Vice Chairman.*

Debt due on the 1st of January, 1846, 2000*l.*

APPENDIX C.

LARGS.

No. 384.
Return to Order of the House of Commons of August 9, 1844.

LARGS.

No. 384.

Return to Order of the House of Commons of August 9, 1844.

SIR, *February* 21, 1845.

I BEG leave to furnish you with an Act of Parliament and copy of plan of the harbour of Largs; also to report that no engineer has examined the harbour of Largs since finished, and that no complaints have been made against the harbour.

I am, &c.,
JOHN C. MACCALL, *Clerk.*

The Honourable H. Manners Sutton,
&c. &c. &c.

No. 385.
Income and Expenditure.

No. 385.

Return of Income and Expenditure for the Years 1841–2, 1842–3, 1843–4.

INCOME.				EXPENDITURE.			
Heads of Income.	1841–2.	1842–3.	1843–4.	Heads of Expenditure.	1841–2.	1842–3.	1843–4.
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Tonnage dues . .	279 4 6½	283 5 9½	314 12 10	Salary, harbour-master	46 16 0	41 12 0	46 16 0
				Repairs to harbour .	37 1 10½	45 7 1½	30 2 2
				Total . . £.	83 17 10½	86 19 1½	76 18 2

Dues levied under the authority of Act 2 Wm. IV., c. 44.

H. CAMPBELL, *Harbour Master.*

MILLPORT.

No. 386.
Return to Order of the House of Commons of 9th Aug. 1844.

MILLPORT.

No. 386.

Return to Order of the House of Commons of August 9, 1844.

SIR, *April* 15, 1845.

THE treasurer of the harbour at Millport, island of Cambrae, county of Bute, has put into my hands yours of the 1st ult., in answer to which you have herewith a plan of our harbour and pier, which was erected by private subscription, and has cost about 1000*l.*; if funds could have been raised it was intended to have the pier further out to sea, whereby vessels drawing 20 feet of water could have sheltered; and if such a thing as a grant of a few hundred pounds could be obtained, this could yet be done; at low-water at present vessels requiring only from 6 to 7 feet water can be accommodated, and at high-water vessels may come in that require 16 feet water. Yet we would be grateful for a grant as above-mentioned, which might have been the means of saving several wrecks of late on this coast in stormy weather, and also this, being a fishing-station, is a nursery for seamen for Her Majesty's navy, &c. &c.

I am, &c.,
GILBERT LENNOX, *President.*

The Honourable H. Manners Sutton,
&c. &c. &c.

No. 387.
Income and Expenditure.

No. 387.

Return of the Income and Expenditure for the Years 1841–2–3.

INCOME.				EXPENDITURE.			
Heads of Income.	1841	1842	1843	Heads of Expenditure.	1841	1842	1843
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Tonnage on vessels and goods . . .	67 12 6	70 11 5	63 12 8	Repairs	287 14 5	19 2 2	3 1 6
Money borrowed .	160 0 0	..	..	Repayment of money borrowed . . .	..	60 0 0	45 0 0
				Interest on ditto .	..	..	11 11 11
Total . . .	227 12 6	70 11 5	63 12 8	Total	287 14 5	79 2 2	59 13 5

Rates of Tonnage: vessels of 6 tons register or upwards, ½*d.*; vessels under 6 tons, 3*d.* per trip; goods landed or shipped, 1*d.* per ton.

A steam-boat pier was extended in 1833, at an outlay of 750*l.*, which was raised partly by donations, and partly by 10*l.* shares; and for the following eight years the revenue did not exceed 5 per cent. to the shareholders. In 1841 it was so damaged by storm, that the expense of repairing it has prevented any dividend being paid to the shareholders.

GILBERT LENNOX, *President of Harbour Committee.*

APPENDIX C.

ARDROSSAN.

ARDROSSAN.

No. 388.

No. 388.
Return to Order of the House of Commons, of August, 9, 1844.

Return to Order of the House of Commons of August 9, 1844.

March 17, 1845.

SIR,

IN compliance with the circulars of the 15th November, 1844, and the 1st February, 1845, I lately forwarded, under your address, abstracts of the receipts and expenditure of Ardrossan harbour for the three years ending the 31st December, 1844, and I now send under the same address in three different parcels, the following plans and reports regarding the said harbour, viz.:—

1. Report on Ardrossan harbour, by Mr. Jessop, July, 1808.
2. Printed statement regarding Ardrossan harbour, 1810.
3. Report on the harbour of Ardrossan, by Rennie and Whidbey, 1811.
4. Report respecting Ardrossan harbour, by Thomas Telford, 1812.
5. Report by James Walker, on Ardrossan harbour, 1839.
6. Extract from report as to expense of opening the docks, &c., at Ardrossan harbour, by Grainger and Miller, 1839.
7. Statement relative to the formation and progress of circumstances connected with the present state of Ardrossan harbour, &c., 1838.
8. Report, by John Moffat, regarding Ardrossan harbour, 1844.

Also, six plans of the harbour and roadstead of Ardrossan.

1. Showing the harbour as it existed from 1819 to 1840.
2. Showing the deep-water piers according to the plans of Jessop and Telford, 1805 to 1811.
3. Showing the deep-water piers, according to the plans of Mr. Rennie, 1813 to 1819.
4. Showing the extension of the wet dock, according to the plans of Mr. Walker, 1839 and 1840.
5. Shows the extension of deep water piers and wet dock, according to plans proposed by Mr. Moffat.
6. Shows a second extension as proposed by Mr. Moffat, both in 1844.

I have, &c.,

The Hon. H. Manners Sutton. GEORGE JOHNSTON, *Treasurer.*

No. 389.

Statement relative to the Formation and Progress, and of circumstances connected with the present State of the Harbour of Ardrossan, with a view to ascertaining whether certain parts of the Works should now be further proceeded with.

October 20, 1838.

No. 389.
Statement relative to the formation and progress of the Harbour of Ardrossan.

THE late Earl of Eglinton was advised so far back as the year 1804, that the formation of a harbour at Ardrossan, on the west coast of Ayrshire, a projecting point which forms the north head of the bay of Ayr, and a canal connecting it with the town of Paisley and Tradestown, a suburb of Glasgow, would be of great advantage to the public, and to the Earl's own estates in the neighbourhood of the harbour, and to those of the other proprietors adjoining the harbour and the whole line of the canal.

The projected canal never was formed farther than from Paisley to Johnston; and more lately it was proposed to substitute a railway in its place, and about six miles of which have been made and are in use, running from Kilwinning to the harbour of Ardrossan. There being now a prospect of a railway being immediately formed along the whole distance from Glasgow to Ayr, and connecting with the harbour by means of this railroad already made, it becomes an object to ascertain whether the prospects thence arising make it expedient to complete certain parts of the works at the harbour, particularly the wet dock; and for the purpose of judging as to this, and of what may be requisite, it seems necessary to attend to the various plans and proceedings that have from time to time taken place, and been acted upon in regard to the harbour.

In 1805 Acts of Parliament were obtained for the purpose of making both the harbour and the canal, and forming two separate companies of both of which the late Lord Eglinton became a principal shareholder.

The plan of the harbour was formed by the late Mr. Thomas Telford, and will be found among the published plates of the Atlas to the Life of Mr. Telford, along with a chart of the bay of Ardrossan, with harbour and wet dock.

It appears that Mr. Telford had reported in 1812, and indeed that a full discussion had taken place regarding the position of Ardrossan as connected with the canal, and the advantages of its situation on the coast for the purposes of a harbour.

The properties of the harbour were too, previous to its being begun, pointed out by Mr. Murdo Downie, a master of the navy.

And in 1805 Captain Sandford Tatham, of the Royal Navy, at that time the Regulating Officer at Greenock, addressed certain letters to Lord Eglinton, containing his views as to the commercial advantages of the harbour and canal.

And in 1806 the Captain also addressed several letters to the Earl, containing further observations and his opinion regarding the harbour bay and canal, and which are printed.

In the meantime reference is made to—

1st. Chart of the bay of Ardrossan, on the west coast of Ayrshire, with a plan of the intended harbour and wet dock, also the town baths and crescent, which are now partly built upon the property of the Right Honourable the Earl of Eglinton. Engraved by J. Moffat, Edinburgh.

2nd. A sketch of the harbour by Mr. Moffat, as it at present stands.

According to the original plan, it was proposed to construct a wet dock of 300 yards in length

APPENDIX C.

ARDROSSAN.

No. 389.
Statement relative to the formation and progress of the Harbour of Ardrossan.

and 100 in breadth, with a depth of water of 16 feet, into the east end of which the intended navigable canal from Glasgow was to enter.

It appears that some deviation from the original plan was very soon contemplated. At a meeting of the proprietors, held only a few months after the Act of Parliament was passed, "the Earl of Eglinton laid before the meeting the plans, in different sections, made out on two different sheets of paper, and a specification of the manner in which the outward wall and bead of the south pier are to be executed, all subscribed by Mr. Telford on the 16th November last, which appeared to this meeting calculated to answer the purpose intended, and also completely to obviate two objections formerly urged against the plan, viz.:—1st. That between the end of the south pier and the dock gates there was too little room for a ship to swing after having cast anchor, to wait an opportunity of entering the dock. 2nd. That the dock gates were too much exposed to the north-west storm. The obviating of the objections appears to this meeting to be a *very great improvement of the original plan*, and they therefore approve of the same." "The meeting had also laid before them an estimate for executing that part of the work now to be done, given in by Mr. John Simpson, upon those plans, sections, and specifications; and as Mr. Telford has given it as his opinion that the estimate is very reasonable, the meeting therefore authorise the Committee to enter into a contract with Mr. Simpson for executing the same, after some points in his estimate shall have been explained, which they are of opinion can only be done when he is present."

It appears that in the course of two years and a half after the work had been begun, a pier had been formed of 900 yards in length, exceeding, it will be observed, the total authorised by the Act, by 100 yards.

At a meeting of the committee of management, held in June, 1808, Mr. Jessop was directed to prepare a report. This report was presented to a meeting of the proprietors, held on the 18th of the following month, and it recommended the extension of the pier to the Crinan Rock, which he described as a "means of affording complete protection, not only to the general coasting trade, but also to ships of large burden, and to most of His Majesty's frigates; and in a country whose existence so materially depends on its commerce and naval superiority, the public utility of harbours is unquestionable." Mr. Jessop goes on to say, "as the depth of water in which such an extension of the pier must be founded, is from 12 to 22 feet or upwards, at the low water of spring tides, the most practicable means that I know of for effecting it at a reasonable expense, is to create a foundation for the pier, by what is called from the French *à pierre perdue*, or throwing in rough stones, which will spontaneously find their own place of rest, beginning with small ones, such as men may throw in by hand, and increasing their size as the height increases, so that at the level of low water they would be from half a ton to two tons in weight, particularly on the external slope: as the stones will lie 2 to 1, the mean width of the base will be about 140 feet."

Further directions are given as to the manner in which the piers should be formed; and there is annexed to the report, an estimate of the expense of extending the pier to the Crinan Rock, amounting to 30,040*l.*; and it is added that Mr. Simpsons's estimate for completing the quay wall, the canal, and the present pier, is about 10,000*l.*

This report having been taken into consideration, and a full conversation had with Mr. Jessop thereon, it was moved by the Earl of Eglinton, and unanimously agreed to, that the plan now given in by Mr. Jessop, of carrying the "south pier to the Crinan Rock, instead of ending it, according to the former plan, be adopted." Mr. Jessop was requested to accept of taking charge, along with Mr. Telford, of the operations now approved of, and Mr. Telford was requested to act cordially along with Mr. Jessop.

It was stated to this meeting by Mr. Simpson, "that about 200 yards of railway will be necessary to carry the work to the end of the south pier as originally proposed; and the meeting authorised the committee to order the same accordingly."

In a printed paper intended for circulation about this time, and titled "Ardrossan Harbour," after stating that the water continues upwards of 18 feet in depth very near to the Crinan Rock, which lies at the distance of 720 feet from the present pier-head, it proceeds, "this space was intended as the entrance of the wet dock; but in course of executing the pier, it appeared that in addition to the wet dock, which is necessary for the commercial operations, a very capacious harbour might be formed by extending the pier from its present termination to the Crinan Rock, into which large vessels might enter, and from which they might depart, at all times of the tide. This rock lies at the distance of 290 fathoms from low-water mark. Immediately within the rock, the depth is 18 feet at low-water in spring ides; at the distance of 40 fathoms, it is 21 feet; and at the distance of 120 fathoms from the rocks, it is 14 feet; from thence to the shore it gradually shallows, at the rate of about 2 feet in each 20 fathoms: a similar depth is found all over the bay within the protection of the pier, where the ground is a smooth hard sand."

At the annual meeting on the 7th July, 1808, a report was produced by Mr. Dunlop, Messrs. William and John Brown, and Captain Robert Brown, made at the request of the committee, upon the best mode of completing the pier-head, so as to give protection to the present building, and to afford room for shipping. The meeting were unanimously of opinion, that it would be for the advantage of the undertaking that the work therein mentioned should be done; but previous to which, they required information to be got of the probable expense.

It was afterwards resolved to execute the work proposed by the report, "as well in regard that thereby suitable and safe berths for trading vessels or transports, to take in either foot or cavalry, will be obtained, and thereby be an inducement to Government to give some encouragement to the work, as that it secures the work already done, and, in other respects, is of much importance and utility to the undertaking." Directions were given to intimate to Mr. Simpson, that his estimate was accepted of, and which it appears amounted to 3,015*l.* 3*s.* 8*d.*, including 285*l.* for the work proposed to be done in a temporary manner.

It appears that in August 1810, Mr. Simpson stated that his contract for executing the north pier might now be considered as at an end; and that it was intended to proceed with other parts of the work, and to procure iron rails for a road from the quarry, as well as to make preparations for proceeding with the work for next season, or building boats, &c., and likewise to procure a proper person at an adequate salary, to take charge of these operations.

At this stage of the works, November 1810, the late Lord Eglinton appears to have presented to the Lords of the Treasury, a petition for himself, and the other proprietors of the harbour, stating the progress made, and particularly what was in view by Mr. Jessop's plan; and that although the 50,000*l.*

ARDROSSAN.

No. 389.
Statement relative to the formation and progress of the Harbour of Ardrossan.

which it was to cost, was not a very large sum for an undertaking of such magnitude, it was much greater than the proprietors found it at the time possible to raise; and that they had been advised to apply to the Treasury for assistance to enable them to complete their undertaking, upon the ground that in a naval and military, as well as in a commercial point of view, its completion was of great importance to the empire.

It was stated, that it was not merely the harbour that was of importance in this respect. Between the island called the Horse Isle, which defends the harbour on the north west, and the proposed pier, which will protect it on the south-west, there is extensive anchorage ground, having a depth of from 4 to 5 fathoms at low water, in which the island of Arran, which is immediately opposite, at the distance of about 15 miles, prevents any swell of the sea, and the largest frigates might here ride in safety at all times, excepting when there is a strong gale at S.S.W., in which case they can come into the harbour.

The petition further contains a statement to the following effect, viz.:—That the pier had been nearly formed to the extent of 900 yards in length, in the shape of a crescent upon the rocks which run out for about half a mile into the sea, but the water deepening to 18 feet at the extremity of this pier, and continuing of this depth to the rock called the Crinan Rock, at the distance of about 640 feet from this extremity;—that it appeared in the course of executing the work, that a most capacious wet harbour or rather roadstead might be formed, by carrying the pier out to this rock, the distance from which at low-water mark, is 290 fathoms. Within the rock, and close to it, and for a distance of 20 fathoms from it, there is a depth of 18 feet at low water; at the distance of 20 fathoms more, it deepens to 21 feet; a depth of 20 feet obtains for 20 fathoms farther. It then shallows to 19 feet, which depth continues for 20 fathoms more. It then falls to 16 feet and at the distance of other 20 fathoms, to 14 feet, which depth is found at the distance of 120 fathoms from the rock. The water continues to lose about two feet of depth, each 20 fathoms, until it comes within 80 fathoms of low water mark, so that for 80 fathoms within the rock, there is found a depth of from 18 to 21 feet at low water, and for the remaining 210 fathoms there is a depth from 16 to 20 feet. A similar depth of water was found throughout the whole of the bay, for the whole length of he proposed pier; that is, from any part of it towards the shore, there is a depth of from 18 to 2 feet for 260 fathoms, gradually decreasing about two feet at each distance of 20 fathoms, and gradually lessening as it recedes inwards from the Crinan Rock. But even at the distance of about 700 feet from this rock, within the harbour, there is found a depth of 12 feet at low water, which in like manner gradually decreases as it approaches low-water mark.

It occurred therefore, that the depth and capaciousness of the wet harbour so capable of being formed, were thus not only greatly beyond what could be obtained by the wet dock as originally proposed, but that this farther advantage would result; namely, that vessels of a large burden might enter and depart at all times of the tide. These considerations induced the harbour proprietors to submit this alteration of their plan to Mr. Jessop, who it appears ascertained not only its practicability, but that it might be accomplished at a total expense not exceeding 50,000*l.*

In consequence of this application to the Treasury, their Lordships issued instructions to Mr. John Rennie and Mr. J. Whidbey, "to examine and report on the practicability of making it a fit place for the reception of His Majesty's frigates, and the smaller vessels of war, and also as to the benefits which may probably be derived from the said harbour, to the public in the embarkation of troops for Ireland, or in facilitating the communication between the two countries in any other matters of public interest or importance, in order that their Lordships may be enabled to form a judgment, how far it may he proper to submit to parliament any proposition for a grant of public money for the attainment of the objects." (See Report, p. 524)

It appears that about this time, reports or plans concerning the harbour, were obtained from—

1st. Mr. R. Stevenson, of Edinburgh, which seems to have had in view limiting the harbour to the space between the Great Crinan Rock and the shore: this report is dated.

2nd. Report by Admiral Sir Charles Brisbane, who had surveyed and sounded the whole bay. In a letter from Lord Eglinton to Captain Taylor, dated the 7th June, 1811, in reference to this report, his Lordship writes, "Sir Charles agrees with Messrs Rennie and Whidbey on the impropriety of carrying the pier to the Crinan Rock. The pier he considers as having been carried too far in the direction, and that had it been carried on, it would have made the entrance into the harbour more difficult."

3rd. Report by Captain George Taylor, of Dublin. It is dated August, 1811, and in a letter from him to Lord Eglinton dated the 16th of that month, he describes it as a "design, estimate, and explanation for the extension of the pier of Ardrossan." He adds, "As to the security which Ardrossan harbour will furnish to shipping when these proposed works are made, there cannot be much diversity of opinion. As far as my opinion goes it will be very complete."

All these reports appear to have been laid before Mr. Telford, who constructed an accurate chart of the whole bay of Ardrossan, including the Horse Isle, and made a report bearing reference to it, and which is dated at Ardrossan, January, 1812. (See Report, p. 525)

It would appear that although Mr. Telford had suggested that a wall should be carried out to the sunken rock, with a view to its forming the termination of the proposed extension; yet, owing to the weather, Mr. Telford had not been able to ascertain exactly the situation of that rock. For this reason, and in order not to rest upon Mr. Telford's report alone, Lord Eglinton also obtained a report, 25th January, 1812, from Mr. Charles Abercrombie, engineer, and Captain Thomas Clark, a person said to be of much nautical skill, and both of great experience.

This report is addressed to Lord Eglinton, and bears,—"In obedience to your Lordship's orders communicated to us, we proceeded on Tuesday last, the 21st instant, to examine the proposed plan for extending the harbour at Ardrossan, and in order to make ourselves masters of the subject, we commenced taking the soundings at low water first in the line of the proposed pier out to West Crinan Rock, which we found nearly as marked on the plan, the length likewise corresponded with the same, amounting to about 1,800 feet from where it will depart from the present pier to West Crinan Rock. We then proceeded to discover and examine a sunk rock supposed to in or near the line of passage into the harbour, the proper situation not having been before ascertained; this sunk rock we found situated nearly at right angles with West Crinan Rock towards the land, bearing east at the distance of 50 fathoms from West Crinan Rock, with 7 feet water on it; and it is our opinion that it should be included in the extension of the pier as marked by us on the plan, and will have the complete effect of covering the harbour from the north, the only wind to which it can he exposed. We then examined

APPENDIX C.

ARDROSSAN.

No. 389.
Statement relative to the formation and progress of the Harbour of Ardrossan.

the North Crinan Rock, likewise marked by us on the plan, on which we found 6 feet water, and bearing east from West Crinan and the sunk rock at the distance of 100 fathoms; and we would here again recommend that upon this rock a building should be carried up nearly as high as the great pier, which building will form the east side of the entrance into the harbour. The soundings in this passage we found from 18 to 20 feet at the time of our survey, which was at low water. This depth of water continues much the same over all the space of the harbour, both within the Great Crinan Rock and likewise between it and the great pier intended; and the distance from the sunk rock and head of the pier proposed is about 100 fathoms; and it is our further opinion that upon this rock a proper building should be carried up as high as the great pier, and properly provided with mooring-rings and steps to ascend on each side, and when executed will turn out of great advantage to the harbour. In the further prosecution of our survey, we sounded the passage or channels from the pier-head intended, out to sea, and found the soundings nearly as marked on the plan, except at one place off the south-west point of the Horse Isle, but the difference appeared to us of no material consequence. The whole channel we found quite clear, with mostly clay or sand bottom, and good anchorage. This harbour will, when finished, be of large dimensions, and will contain a number of vessels, and of sufficient draft of water for any ships now navigating the Firth of Clyde. But it gives us considerable surprise to be informed by a report put into our hands by two gentlemen employed by the Lords of His Majesty's Treasury, that it would be exceedingly difficult for a ship to work out of this harbour, with a wind up channel; this we consider as rather unfounded, and can by no means agree to; and it is clearly our opinion that when any vessel can work to windward down channel, they can at the same time work out of this harbour; and we can take upon us to prove that fact at any time when the work shall be carried into execution, or even properly marked off with sufficient perches, which may and ought to be done immediately. And further, we are of opinion that it will make a safe and convenient and capacious harbour for all vessels corresponding to its depth of water at 20 feet at low water, and 30 feet and upwards at high water."

These reports were under the consideration of a meeting of the proprietors of the harbour, held in March following, at which Lord Eglinton stated, "that he meant to go on with the work recommended and planned by Mr. Telford, as before stated, at his own expense, or with such further subscriptions as may be received." The meeting are of opinion that the execution of the plan now produced would be of very great importance to what has been already done, and does away with all the objections brought against the harbour, and therefore would be of much advantage to the subscribers at large.

In the month of July following, Captain George Taylor addressed the following letter to Lord Eglinton:—"Having had occasion to be in the north of Scotland in the beginning of last month, I did myself the pleasure of taking Ardrossan in my way, and was much gratified in finding the work going on so well. Mr. Telford's last plan was shown me, which no doubt promises much; but the great expense of executing it to the full extent, induced me to consider if any other mode could be devised to answer the present purpose at less cost, without interfering with future views of more extensive improvements. I would, therefore, recommend to your Lordship to consult Mr. Telford on deepening round the pier-head, and along the front, or loading-place, a space of the length of three vessels, and of the breadth of two, to 10 or 12 feet at low-water spring tides. The means of doing it would be by placing two augers, of a ton weight each, on a lighter, with a small steam engine to work them when the stone or rock should be pounded to sand; it might be removed or dredged out in the ordinary way, or by machinery, wrought by the engine, on a small scale. This is merely the operation of boring stone, and I imagine would not amount to great cost, as the rock is soft. Under this impression it would be desirable to contemplate the termination of the present mound or pier on the Brisbane rock, provided the harbour should not immediately be made a national work; whenever it shall be undertaken by Government, Mr. Telford's plan may be carried to the full extent. This mode would certainly render it a safe harbour, not inferior to any harbour on the coast, and far superior to any dry harbour, being accessible at all times of tide, and large enough for the trade that may be expected for some years; and when an increase of shipping shall require more accommodation, the same means would procure it, by extending the deepened space without injury or interruption to the future view of communicating with a canal basin, which would, with equal convenience, be made farther up towards the town. Upon the principle of Mr. Telford's first design, it was meant that the canal basin should be the place of safety for vessels to lie in afloat, which would have required large space; but the excavated space would also be safe, and would lessen the extension of the canal dock when it comes to be made, and it is imagined would improve the whole design. The land taken out of this excavation might be thrown over the parapet wall of the pier, nearly opposite to the inn, with a view of forwarding an operation of the sea in raising the space between the town and the island, which the pier has already had the effect of raising considerably, and no doubt will, in time, make dry land. It occurs also that it will be necessary to sink deeper in the quarry, in order to obtain the quantity of stone required, otherwise too much of the ridge may be cut away."

In the month of September of the same year (1812) that all the reports last mentioned were obtained, Mr. David Henry, the superintendent of the works at Ardrossan, made out the following description of the harbour of Ardrossan, viz.:—

"Accompanying this is a map or chart of Ardrossan Point and part of the bay, and Horse Isle, on which is delineated a plan of the new town of Ardrossan.

"This plan is upon a much larger scale than the original one, the great pier running out in the direction of the Horse Isle, and is coloured red on the plan, is not wholly an addition or an extension of the original plan.

"The original plan was only proposed to form an entrance or communication with the canal now in progress of making, from Glasgow to this place, a considerable part of which is now completed.

"This entrance comprehended only the wet dock, the two piers inclosing it, and the tide lock, as they are shown upon this plan.

"The surface of the water in the dock will measure from 8 to 10 acres, with a depth of 16 feet, and 6 feet over the lock sill at spring ebbs, &c.

"This would no doubt have made a good harbour, situated as it is, but still it was not making the most of all the natural advantages the situation afforded; and in order to do this (in addition to the above) the great pier with the breakwater on the south and east sides of the Horse Isle have been recommended and adopted, by which means there will not only be formed a very extensive and commodious harbour along the inside of the great pier, where vessels of large dimensions may lie afloat

No. 389.
Statement relative to the formation and progress of the Harbour of Ardrossan.

at all times of the tide, even at spring ebbs, in from 20 to 25 feet water; but also a great extent of the bay will be converted into a harbour where vessels may lie at anchor in safety, sheltered from almost every wind, but especially from those most prevalent, viz., the S.W. and W. and N.W. (the land being towards the other points) in from 16 to 24 feet water at all times of the tide, as will appear from the soundings on the map, which are all taken in feet at low-water spring ebbs."

The forming of this extension, or great pier, is now commenced upon, and is extended in length about 130 yards: its dimensions when finished will be nearly as follows:—

"Length in the deep water, including the turn at the pier-head, 700 yards, besides 150 yards long at the south end in shallow water, joining the pier already built; width at top, about 15 yards, sloping on the outside at 2 horizontal to 1 perpendicular, and on the inside 1 to 1 at bottom, and to become more perpendicular as it advances towards the top, where the bottom will be about 3 inches in a foot; height above high-water spring tides to bottom of battlement, about 7 feet; the height of battlement 11 feet; the average depth from high-water spring tides to bottom, will be about 34 or 36 feet.

"The pier will be formed of hard whinstones, of very large sizes, tumbled into the sea promiscuously; the outside towards the sea will be formed with the largest and youngest of the stones laid to the proposed slope, with their ends inwards, at least above low water, but without any mortar or dressing of the stone; the inside of the battlement will be of Ashlar stones, set in mortar.

"The face towards the harbour below low water will be formed also with the largest of the whinstones, dropped down in the inside of a framing of wood, which will be put down to preserve the direction of the face, and also to defend vessels from rubbing on the stonework; the top part of this breast, or that above low-water mark, will also be formed of large whinstones, set without mortar in a sort of regular courses."

"In addition to the above, the plan also points out very convenient situations for graving docks, yards for ship building, timber-yards, rope-walks, market-places, &c., &c., as may be seen by inspection."

It appears that early in 1814 a communication had been made to Mr. Rennie respecting what was in progress at the harbour, and that of this date (12th March, 1844) he had written stating his objections. Neither the communication to Mr. Rennie, nor his answer, has been recovered.

No. 390.

Report of WILLIAM JESSOP, Esq., C.E., *on the Extension of the Pier; and Estimate.*

No. 390.
Jessop, on the Extension of the Pier; and Estimate.

MY LORD, *July* 18, 1808.

THERE can be no doubt that the extension of the pier of Ardrossan to the Crinan Rock will be the means of affording complete protection, not only to the coasting trade, but also to ships of large burthen, and to most of His Majesty's frigates, and in a country whose existence so materially depends on its commerce and naval superiority, the public utility of safe and convenient harbours is unquestionable.

As the depth of water in which such an extension of the pier must be founded is from 12 to 22 feet and upwards, at the low water of spring tides, the most practicable means that I know of effecting it at a reasonable expense is to create a foundation for the pier by what is called from the French *à pierre perdue*, by throwing in rough stones, which will spontaneously find their place of rest; beginning by small ones, such as men may throw in by hand, and increasing the size as the height increases, so as at the level of low water to be from half a ton to two tons in weight, particularly on the external slopes. As the stones will lie as two to one, the base will be 140 feet in mean width.

When the base shall be raised to within 6 feet of low water, so as to be visible in calm weather and be levelled and regulated, I would sink frames of timber formed of half balks, as shown on the section, to give band to the loose stones on which they may rest, and on these frames heavy stones may be sunk and pitched with some regularity; these stones forming an apron of about 18 feet 6 inches in breadth, will receive the returning wave without being disturbed; and this apron by the wave glancing from it will also give protection to the stones below it. If any of the stones which are below it should be displaced, the frames will support the superstructure until others might be thrown in at the level of low water. Other similar frames should be laid, on which to found the regular masonry of the pier, which in form and construction may be such as is already done on the present pier.

The stones most proper for the sunken foundation will be obtained from the Whinstone Rock near the harbour, as their specific gravity is considerably greater than that of the freestone; but the coarsest of the freestones may be most proper for the part described as an apron, as their regularity of form, and their magnitude will be greater than what can be obtained from the Whinstone Rock.

As the slope of the sunken foundation will not admit of ships lying at the quay within the harbour, it will be necessary for at least 100 yards in length to found the quay on caissons to the depth of 9 feet in low water, so that vessels may lie alongside of it; and for this extent it will be necessary to have the width at the level of the quay about 60 feet, so as to continue the canal thereon, from whence, by cranes, the lading of the boats may be transferred to the ships; but the remainder of the pier may be contracted to 30 feet at the level of 5 feet above the high water of spring tides.

During the progress of the sunken part, some derangement of the loose stones by the storms of winter will be inevitable; but as it will be comparatively cheap work, and it will tend to strengthen itself by such derangement, by increasing the base, it must be patiently suffered: to what extent this may happen it is impossible to foresee; and if this work be considered, as I presume it may be worthy of national aid, it will be of little importance.

I have, &c.,
WILLIAM JESSOP.

The Right Hon. the Earl of Eglinton.

APPENDIX C.

ARDROSSAN.

No. 390.
Jessop, on the Extension of the Pier; and Estimate.

Estimate of the Expense of extending the Pier to the Crinan Rock.

	£.	s.	d.
3820 cubic yards of rubble in the base, at 4*s.* per yard, measured in the work, or 2*s.* 6*d.* per ton	7,642	0	0
Timber frames	470	0	0
Caissons	960	0	0
Masonry in the caissons	940	0	0
On the wall of the pier, at the prices of present pier	9,310	0	0
Inner wall or quay, at ditto	2,640	0	0
5,400 cubic yards of filling up, battering the walls, including puddle for canal, at 2*s.* 6*d.*	675	0	0
4,680 of ditto to the end of pier	585	0	0
100 running yards of walling in canal, at 1*l.* 10*s.*	150	0	0
Coping to ditto	150	0	0
Iron works, &c.	350	0	0
Cranes, moorings, &c.	500	0	0
Drawbridges over canal	250	0	0
For boats and waggons	1,500	0	0
	£26,122	0	0
Contingencies, 15 per cent.	3,918	0	0
	£30,040	0	0
Mr. Simpson's estimates for the completion of the quay wall and canal on the present pier	10,000	0	0

No. 391.

Statement relative to the Capabilities of the Harbour of Ardrossan. 1810.

No. 391.
Statement relative to the capabilities of the Harbour of Ardrossan.

IN forming a pier already carried out to the length of 900 yards, a sum has been expended to the amount of 18,000*l.* and upwards.

The completion of this harbour embraces two objects, namely, that part of it which relates to its commercial purposes, and that part of it which relates to its naval and military purposes, with reference to public objects: which are most important, as they regard the easy and expeditious transport of troops to Ireland. The latter objects, to which this statement is confined, are to be accomplished by extending the present pier to a rock called the Crinan, at the distance of about 720 feet from the present pier-head.

By this extension there will be a depth, close to the pier for upwards of 700 feet in length, of from 15 to 22 feet at low water; which will enable from fifteen to twenty transports, in two or three tiers, to lie afloat at low water close to the pier, from whence they may immediately proceed to sea at all times of the tide, and with every wind.

A large and commodious harbour will likewise be formed within the pier, with excellent anchorage, having throughout a great part of it a depth of from 18 to 22 feet at low water; and as the Crinan Rock is 290 fathoms from low-water mark, from whence the water deepens at the rate of about 2 feet in each 20 fathoms, some idea may thus be formed of the capaciousness of the harbour.

About two years ago, an estimate was made by Mr. Jessop, of the expense of this extension, in which he calculated the amount at 30,040*l.* From the increased price of timber, and the rise in the price of labour since, it may not be too much to estimate the whole expense now at 40,000*l.*

If such a sum shall be provided, the work may be completed in four years from the time at which it may be begun, which will require issues at the rate of 10,000*l.* per annum, and each part of the pier, as completed, will become useful in the embarking of troops.

No. 392.

Messrs. RENNIE and WHIDBEY, *on the State and Capabilities of the Harbour.*

No. 392.
Rennie and Whidbey, on the state and capabilities of the Harbour,

SIR,

London, February 11, 1811.

IN compliance with the directions we received from the Right Honourable the Lords Commissioners of His Majesty's Treasury, communicated to us by George Harrison, Esq., on the 13th day of November, 1810, directing us to proceed to the harbour of Ardrossan, in Ayrshire, and examine that harbour, and report on the practicability of making it a fit place for the reception of His Majesty's frigates, and other smaller vessels of war; and also on the benefit which may probably be derived from the said harbour to the public, in the embarkation of troops for Ireland, or in facilitating the communication between the two countries in any other matters of public interest or importance, in order that their Lordships may be enabled to form a judgment how far it may be proper to submit to Parliament any proposition for a grant of public money for the attainment of these objects; and having been furnished with various papers on this subject, which we have examined, together with the harbour of Ardrossan; we beg you will be pleased to lay the following observations before the Lords of His Majesty's Treasury.

That we have been at the harbour of Ardrossan, which we have examined and sounded with great care and attention, to ascertain its fitness for the purpose referred to our consideration. We found that a pier had already been built from the mainland, of about 900 yards in length, on a ridge of rocks, which are for the greatest extent dry at low water; and the head of this pier terminates, not at the extremity of the ridge of rocks, but at a place where there is about 3½ feet depth at low water. From the pier-head the ridge gradually descends for about the distance of 70 yards, where the depth is about 5½ yards; and from this point to the Great Crinan Rock, a distance of 240 yards, the water is generally deep being from 17 to 22 feet, and the bottom pretty regular.

No. 392.
Messrs. Rennie and Whidbey, on the state and capabilities of the Harbour.

Within the shelter of the above-described pier, there are many rocks which are dry at low water; and, indeed, the water ebbs nearly to the head of the pier. Little shelter, therefore, is obtained from the pier now built, beyond what was previously given by the rocks themselves. All vessels which come into this harbour while it remains in its present state must be aground at low water, which renders it an improper place for any of His Majesty's ships.

Troops, however, may be embarked in transports from the pier, and at a proper time of the tide in moderate weather; but if the wind is from the west and south-west quarters, and blowing strong, we are afraid the transports would be in considerable danger, as they would not get to sea, and must lie in an exposed situation, or beat upon the ground at every tide, if hauled within the pier; but in this latter case the number must be very limited, as the place sheltered by the pier is so very small, and generally too shallow.

To obviate these defects it has been proposed, by Messrs. Jessop and Telford, to build a pier from the head of the present to the Great Crinan Rock, which they estimate at £35,923, and within the harbour they propose to construct a wet dock and lock, which they estimate at £29,007,—making a total, for the completion of the plan, of £65,000.

Were the above-mentioned works to be executed, Ardrossan would then be a harbour fit for merchant vessels of a moderate size, King's cutters and brigs, but would not, in our opinion, be a fit place for the resort of His Majesty's ships of a larger class; 1st, because the deep water within the pier is so very limited in extent, (of 16 and 18 feet,) and lies nearly parallel to the pier; 2ndly, because the direction of the pier intended to be built from the head of the present to the Great Crinan Rock, lies nearly north and south; and 3rdly, because there is a sunken rock which lies about 100 yards N.N.E. from the Crinan, so that by the great runs of sea, which would be sent along the new pier in southerly and south-westerly winds when blowing fresh, a vessel while entering it would be driven on the sunken rock mentioned above, and the more especially so as she must have room for to luff up within the pier, on account of the narrow extent of deep water, and the little space there is to fetch up in, which would render the harbour so dangerous as in our opinion to make it unadvisable for any King's ships of a larger class than cutters or brigs, to resort to it in such winds, which are the prevailing winds of the country; nay, we are inclined to think that in such weather moderate sized merchant ships would find it difficult to enter the harbour in safety.

In working out of the harbour in such winds, there appears also much hazard; a vessel cannot stretch to the north because of a reef of rocks, or to the west on account of the Little or West Crinan Rock, nor to the north-west on account of the Horse Island; to the south she cannot work, so that in south-westerley winds, when blowing fresh, it will be found difficult, if not impossible for vessels of considerable burthen either to go into or out of the harbour, if constructed as proposed.

These objections would be in a great measure removed, although, perhaps, the difficulty of executing the work might be increased, by building a pier in a more westerly direction than what is proposed; namely, by commencing it from the third kant from the head of the present pier, carrying it along a rock which lies to the westward, nearly north-west and by north, and making the entrance to the harbour between the head of this pier and the Great Crinan Rock, instead of between the Great Crinan Rock and the sunken rock before described, and also connecting by a pier or breakwater the Great Crinan Rock and the sunken rock.

By this plan, the entrance to the harbour would be rendered easy in all winds; room would be afforded for vessels to fetch up, and the space for vessels to lie in increased.

Vessels could work out of such a harbour in all winds, if not blowing too strong, without danger, but if blowing strong we do not think there is sufficient space for them to work to windward between the Horse Isle, West Crinan, and Eagle Rocks, there being no tide to hold them.

With respect to the use the harbour of Ardrossan, when it is completed, would be of to the public, for the purpose of embarking troops, and facilitating the communication with Ireland, we beg leave to state that the local situation of Ardrossan is very favourable for collecting troops, providing them with quarters, and embarking them, (when the harbour shall be made,) and probably there is no part on the coast that does possess greater advantages on the points above mentioned; but with the winds before spoken of, we are afraid transports would never reach Ireland, as they could not get out of the harbour, while such winds continued to blow.

We have, &c.,
JOHN RENNIE.
J. WHIDBEY.

Geo. Harrison, Esq.

No. 393.

Report by THOMAS TELFORD, Esq., C.E., *on the best means of obtaining an extensive and commodious Harbour at Ardrossan.*

Ardrossan, January 4, 1812.

No. 393.
Telford, on the best means of obtaining an extensive and commodious Harbour at Ardrossan.

THE position of Ardrossan as connected with the canal having formerly been fully discussed, and the advantage of its situation on the coast, as regards the facility of entrance and departure, being generally admitted, the present object is to ascertain the best means of acquiring an extensive and commodious harbour, where a number of sharp built vessels of considerable burthen may be afloat at low water in well sheltered situations, and also of connecting it with the Glasgow and Ardrossan canal, by means of wet docks.

1. It being the opinion of able and experienced nautical men who have examined the place, that the space between the Great Crinan and the shore, is too confined and difficult of access to form a proper harbour; any plan which shall embrace that space only is, of course, totally inadmissible. I shall therefore avoid any remarks upon the project proposed by Mr. Stevenson.

2. In order to be able to form a correct judgment of the effect which would be produced by the extension proposed by Captain Taylor, I have constructed an accurate chart of the whole bay of Ardrossan, including the Horse Isle, and laid down that extension; but it appears, that although with a southerly wind, the immediate entrance would by this means receive some additional protection, yet to the west and north-west winds (which are here prevalent and frequently stormy) the entrance would be very nearly as much exposed as at present.

Appendix C.

Ardrossan.

No. 393.
Telford, on the best means of obtaining an extensive and commodious Harbour at Ardrossan.

3. By constructing a pier or mound, nearly in the direction of that proposed by Captain Taylor, and extending it about 500 feet beyond the point at which he has terminated, a safe harbour of a certain extent would be obtained in from 18 to 23 feet water, at low water of an ordinary spring tide, and there would be an entrance between the pier or mound and the Great Crinan, of about 250 feet in breadth; but with winds from west to north-west, even this roadstead would be very limited, because a considerable proportion must always be considered as an entrance to the harbour. This I therefore consider as the smallest admissible extension to obtain a harbour, and the proportion gained is not great when compared with the extent of the pier or mound.

4. But the before-mentioned pier or mound itself would occupy the most valuable portion of the harbour, and we shall continue to labour upon a very contracted scale, unless we embrace a much larger portion of the bay, which is protected by the Horse Isle; the protection to be derived from the island may also be nearly doubled by constructing rubble stone mounds in the situations and directions shown upon the chart which I have made. This might be done at a moderate expense, and would create an effectual shelter from the N.N.W. and W. and combined with the appropriate land and pier already built, would leave only from S. to W. to be protected. To accomplish this effectually, and enclose an extensive space with deep water, and a good bottom, a mound or pier of Whinstone rubble should be carried from the present pier in a curved direction, so as to terminate at the West Crinan; this would still leave upwards of 500 yards of clear entrance in deep water between the termination of the mound and the Horse Isle.

By this plan the whole of the bay would in a great measure be converted into a harbour, and a very considerable proportion of it, near to the entrance, would be completely sheltered in all winds. The scale of operations is here very great, and would unavoidably be very expensive. But it appears to me after much consideration to be the only means of effectually embracing all the natural advantages of the place, and rendering it worthy of its singularly advantageous situation upon this prominent point of the coast.

The whole of the piers or mounds I have here proposed being merely for the purpose of shelter may be wholly constructed with rubble stone; and for the principal pier materials may be procured from the hills of Whinstone, which are adjacent to the baths; they may be conveyed along iron railways, and thrown in promiscuously, until brought up nearly to the level of low water; afterwards the outsides should be laid with some degree of regularity. The mound or pier should be raised about 6 feet above the level of high water of an ordinary spring tide. It should be 25 feet in width at the top, the outside to slope at the rate of 2 to 1, and the inside 1 to 1, both upon an average. From the back part of the present pier, which would be enclosed in the mound, there might be procured a sufficient quantity of cut freestones to form the coping of the new parapets.

The mounds upon the Horse Isle should be about 10 feet in width at the top, and have the height and slopes the same as described for the great pier.

Having bestowed much pains to render the annexed chart full and correct, it is hoped, by the aid of this general description, the proposed improvements will be distinctly comprehended.

Thomas Telford.

No. 394.

Report by James Walker, Esq., C.E., F.R.S., *on the Harbour of Ardrossan.*

No. 394.
Walker, on the Harbour of Ardrossan.

23, *Great George-street, March* 7, 1839.

On the 9th November I received a letter from Lord Eglinton, then in London, stating very briefly the early history and present state of Ardrossan Harbour; "that the works were stopped about twenty years since, but that in consequence of the prospect there now is, that the communication between Glasgow and the west coast, and along the interior of the country, will immediately be opened by a railway now in progress, there appears reason to think that certain of the works should now be completed, and others extended, with a view to afford accommodation to such steam-vessels and general trade as are likely to frequent the harbour, and requesting my advice and assistance."

A few days after this, I had a very short conversation to the same effect at Dover, with his Lordship, who informed me he had written to Mr. Tod, his agent, in Edinburgh.

On the 3rd December, I saw Mr. Tod in Edinburgh, when after a conference, he put into my hands a variety of papers and documents, and a very long narrative of the formation, progress, and present state of the harbour, with a view of ascertaining whether certain parts of the works should now be further proceeded with.

On the 10th December I arrived at Ardrossan, and on the following morning Captain Hamilton and Captain Montgomery, attended me. These gentlemen, and Mr. Moffat, engineer to the Ardrossan and Johnston Railway, gave me every information and assistance in their power.

On the 12th December, we were joined by Mr. Miller, civil engineer.

As there was no plan of the harbour or works in their present state, my assistant Mr. Redman, immediately began a survey, and while I was there completed the same, and has since prepared a plan, which will be found nearly correct. A copy of the plan, upon which the proposed lock and addition to the dock afterwards referred to are shown, coloured red, accompanies this report.

It would answer no good purpose now to give another edition of the various professional opinions that have been given relative to this harbour, and the various changes which, acting under these opinions, it has undergone, unless where, taking the harbour as we now find it, the opinions are likely to be of use for guidance as to the future; and unfortunately in this respect, to complete the last designs of either of the two eminent engineers that were consulted (the late Mr. Rennie and Mr. Telford) would involve so great an outlay as would but ill accord with the ideas of either Lord Eglinton or his agent, so far as I could collect them.

Of these designs, one proposes to extend a pier out to the West Crinan, a distance of 400 yards from the present work, where it is is terminated by a large and bold circular head, the average depth at low water being 25 feet. This would protect the space within it from southerly, but be of little use in north-east winds, and in addition to the very heavy expense, would shut up the best entrance which is between the West Crinan and the shore, and confine the entrance to the outside of the West Crinan, where there are several dangerous rocks. As some of these rocks are not shown upon the plan; one

APPENDIX C.

ARDROSSAN.

No. 394.
Walker, on the Harbour of Ardrossan.

is almost led to suppose that they were unknown at the time. Probably the last suggested plan by either of these engineers, is that of Mr. Rennie, which is before me, signed by him in 1815.

In order to enlarge the harbour or space to the eastward of the pier, Mr. Rennie proposed to run his work from the present westerly termination for 300 yards in length in a nearly due west direction, and then to return by a right angle in a north (by compass) direction towards the West Crinan, but leaving a space for the entrance 100 yards wide, between his pier and the West Crinan. This (cost aside) I consider a great improvement upon the former plan. A breakwater was proposed to be run from the West Crinan to a rock which lies nearly true north of it, distant 400 yards. This breakwater would be nearly parallel to the Horse Island, and being inside it and more to the south, would effectually shelter the large portion of the bay, which would be enclosed by it from all seas except from the north to the north-east, to which it would still be open.

A light-house was by this plan proposed, and would be very suitably placed upon the Crinan; it would be a guide directly into the harbour.

The great length of pier and breakwater together, nearly 1000 yards, would make this the most expensive of all the plans. I have no estimate of the work, but as every lineal yard of the section which accompanies the plan contains 815 cubic feet of stone, I think the 1000 yards in length could not be estimated under 300,000*l.*

Considering thus the cost, the change that within the last twenty years has taken place by the introduction of steam-vessels for the coasting trade generally, the shelter which the harbour already possesses from the land and rocks that surround it, and the changes that are going on in the modes of conveyance by railways, one of which may shortly extend from Liverpool to the west coast of Scotland, I do not think it advisable to carry the works further out into the bay, but rather to endeavour to turn to advantage the large sums that have already been expended, so as to accommodate them to present circumstances. This would I think be best done by finishing the dock, and constructing a lock capable of receiving the largest steamer likely to navigate the Clyde.

But before stating the details of the works, I would premise, by way of encouragement, for even the comparatively small works I have to propose, and to prevent any recommendation being subject to the charge of advising good money to be thrown after bad, that the speculation of harbour-making at Ardrossan has not been so daring as may at first sight appear, and as I was led to suppose.

Looking at the expenditure, and comparing it with the revenue received in the shape of harbour dues, &c., the case is bad enough; the cost of the works upwards of 100,000*l.*, the gross revenue to the 1st July, 1838, 880*l.*, and the great proportion, if not the whole of this revenue consumed in the expenses of management and of *dredging*, to clear the entrance of the harbour. Since 1829, when the harbour was opened, the outgoings, including some works done, have exceeded the income by 14,000*l.*

But there is another view of the question which gives a very different appearance to the account. It is, I think, evident, that the coal fields which have been opened owe their trade, and indeed their being opened to any extent for the supply of any other than the immediate neighbourhood, to Ardrossan harbour, unless indeed we suppose a railway to Irvine, and an improvement to that harbour, which would have its own difficulties and expenses.

Previous to the opening of Ardrossan harbour, Irvine was however the shipping port for the coal, and I was informed, that as the full cargo could not be shipped in the harbour, owing to want of water, it had to be made up in lighters outside. The cartage tolls and harbour dues brought the cost from the pit's mouth to the vessel to 2*s.* 9*d.* per ton;* whereas, the cost by the railway and on board in Ardrossan harbour is 1*s.* 6*d.*†, making a difference of 1*s.* 3*d.* per ton, which exceeds the lordship payable to Lord Eglington and others by 2*d.* per ton. If therefore the working of the mines is one of the results of the harbour, the owners of the coal and stone estates should give the harbour credit for the lordship they receive.

Now there was shipped last year at the harbour 62,000 tons of coal and 10,000 tons of stone; supposing the lordship on both equal, the amount of it is 3,900*l.*: the quantity is increasing, and expectation held out, that it may exceed 100,000 tons annually, which would make the amount of lordship, including stone, 6,000*l.* per annum; and this, from the extent of the coal field,‡ may be considered a perpetuity.

The increase of population, the formation of the village of Ardrossan, and the general improvement of the estate through these causes may be considered, the effects of the harbour; and these cannot be removed.

The probability of the general trade remaining at Ardrossan, or of its being increased, must depend upon the advantage of that port compared with others, and particularly Troon, which therefore I visited and received every attention from Mr. Wilson the engineer, and Mr. M'Curdie the harbour master. Troon is a much larger harbour than Ardrossan, the outer harbour of the former being stated at 30 acres, while that of Ardrossan, where there is depth for vessels to lie at the quays, is not a third of that size. The depth at Troon at low water of an average spring tide at the pier, is stated to be 17 feet, and at the upper end 11 feet, while at Ardrossan the depth at the pier-head does not exceed 10 feet. The width of Troon Bay, in front of the entrance, is from 1 to 2 miles with good depth of water, and no rock nearer than half a mile from the pier-head, so that there is room to *work* into the harbour, and ships can get out of the harbour with winds when they can go to sea.

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*	*s.*	*d.*
Cartage, 3½ miles, per ton	2	0
Tolls and Portage, 4*d.* per cart	0	5
Harbour Dues	0	4
	2	9

†	*s.*	*d.*
Six and half miles Railway Tolls, average 1½*d.* per mile	0	9¾
Horse and Waggons, 6½ miles, at 1*d.*, say	0	6
Harbour Dues, including hurry, &c. per ton of 28 cwt., 3*d.*	0	2
	1	5¾

‡ About 1,400 acres, on which the seams are 3½ yards thick, making the quantity (in tons) seventeen millions, of which about one half belongs to the Earl of Eglinton, and the other half to Sir James Cunninghame and others.

APPENDIX C.

ARDROSSAN.

No. 394.
Walker, on the Harbour of Ardrossan.

Ardrossan on the contrary, has the mainland in front of the entrance within half a mile, and is surrounded by rocks of various sizes, some visible at low water only, others at half tide, and some covered at low water. The largest is the Horse Island, which is considerably above high water. The rocks, however they increase the difficulty of entering, act as *breakwaters* to the harbour, and thus give it a decided advantage in point of security. The Horse Island is 900 yards in length, and extends in a northerly direction 1,200 yards from the pier-head; the entrance to the harbour from the north end of the island, bearing S.S.E., and from the south end about S.E. by E., thus covering the entrance from all winds between N.N.W. and N.W. by W. Troon, on the contrary, is very open to northerly winds. Ships are stated to have suffered much at different times, but in none more so than in the storm of January last, when very serious damage indeed is reported to have been done to the shipping in that harbour, while in Ardrossan no loss of any kind was suffered, although, when the storm began, the wind was S. by W., and came gradually round to W., and S.W. winds are the worst for a heavy swell in Ardrossan harbour.

The following extract from Mr. Telford's report gives the opinion of that eminent person on the comparative safety of Ardrossan.

"The district of Argyleshire called Cantyre, and which stretches far into the sea and opposite to the northern extremity of Ireland, forms a barrier against the Western Ocean. The island of Arran, which lies within Cantyre, serves as a still further protection, and leaves this part of the coast exposed only to winds from S.W."

"The whole of the bay of Ayr must be peculiarly affected by the winds from this quarter, and it is only to the north of Ardrossan head, which lies about a mile and a half to the north of Saltcoats, that a complete protection against these winds is met with."

Mr. Telford afterwards observed,—

"From the head of Ardrossan, which is of itself very prominent, and a good land-mark, a ledge of rocks of about half a mile in length, runs into the sea in a direction nearly N.W., and pointing within the Horse Island; at the distance of about three quarters of a mile from this ledge of rocks lies the Horse Island, about half a mile in length, and nearly as much in breadth, which protects Ardrossan Bay from the west and north-west winds.

"The access to the bay is good, being in from 6 to 3½ fathoms at low-water ordinary spring tides, with a bottom of clean smooth sand."

A report made the same year by Mr. Murdoch Downie, who had been a Master in the royal navy, and also some years in the merchant service, thus describes the outlet to the sea:—

"There are scarcely any tide harbours from which ships can depart, without the assistance of a fair, or at least a leading wind; but in this harbour, no wind need detain a ship while the weather is moderate. The west and north winds are those that are most against a ship's sailing out. With the winds at W., and moderate weather, there is room for a ship to turn to windward, out between the pier-head and Crinan rock, or if she should not choose to turn out there, she need only wait till high water, and (if not exceeding 13 feet draught of water) she may then stretch to the northward, within the Horse Island, and thus get to sea that way."

Mr. Downie afterwards adds,—

"Farther from the situation of this harbour, with respect to the coast on each side, there is no risk of ships (when happening to be close in with it) being embayed with sudden on shore gales of wind."

It may be added, also, that the difficulties of entering Ardrossan are less felt by steamers, by which a great portion of the coasting trade and all the trade in passengers may now be said to be done.

In reference to the passenger trade, distance is a consideration. On the county map, from Ailsa Craig to the west of the Cumbraes in a straight line, is 33 miles; between the same two points by way of Ardrossan, the distance is 37 miles; and by Troon, 44 miles; giving seven miles in favour of Ardrossan.

The question of further outlay is not now as if the works were not begun, but whether much being done already, it is prudent to proceed further; and my opinion, to the extent I have already stated, is affirmative, if the rates in the Act are fair compensating rates.

It was agreeable to me when in Edinburgh to learn from Mr. Tod that my ideas so nearly correspond with those of Mr. Miller, which, until then, I was in entire ignorance of: the dimensions of the lock he recommended (220 feet long by 60 feet wide) are exactly what I had drawn. To build this lock, the portions of walling of a similar lock already begun will have to come down.

The depth upon the sill at high-water spring tides will be 20 feet and at average low water 11 feet. I have supposed the walls which will form the wings of the lock to be retained on the east side as a quay wall for steamers, but not to such a length as to prevent a *beaching* place being left, which I think a very necessary appendage in case of a vessel coming in *with way* upon her.

The outer gates of the lock will require to be very substantial; they will be subject to considerable swell, to prevent the injurious effect of which, a strong boom across the entrance will be required, and as I have not witnessed a gale at Ardrossan, I do not pledge myself that this will be sufficient; if it should not be so, I know no better way than by extending the walls on both sides something after the dotted lines shown on the plan; but this will be expensive, and may, I hope, be dispensed with.

The lock will communicate with the dock, which I propose enlarging to 5½ acres, with quay walls round the same.

An exact section for the quantity of excavation has not been taken, but from a general estimate, I think that the whole of the above-described works with contingent expenses cannot safely be put down under 35,000*l.* or 40,000*l.*

Whether as respects the general success of the harbour, and the safety of vessels, particularly large steamers, which are apt to damage by grounding, or the convenience to passengers and goods as an appendage to the Glasgow and Ayr Railway, the dock will be very convenient, and will place Ardrossan in a favourable position, giving it in this respect an advantage over every harbour in the Clyde, the port Glasgow dock, the only one in the Firth or river being unfinished.

The Ardrossan and Johnstone Railway, 5 to 6 miles in length, will connect the harbour with the main line between Glasgow and Ayr. To make the branch line effective, alterations and additions are required. These Mr. Miller and Mr. Moffat have surveyed. Every encouragement and assistance should be given to get this line perfected, and the more the Glasgow and Ayr Railway Company are interested in this branch by purchase or otherwise, the better for the Harbour; this is very evident, and I trust that the opportunity will not be lost, for if by unreasonable terms or indifference, the

APPENDIX C.

—

ARDROSSAN.

—

No. 394.
Walker, on the Harbour of Ardrossan.

trunk Company are led to connect themselves directly or indirectly with a branch to any other harbour, as Troon, which has an advantage, being only from one and a half to two miles from the main line, the effect would be very injurious indeed to Ardrossan; so much so, that I should then question the propriety of expending more money at Ardrossan. I name this to enforce as strongly as I can the importance of a union of interests in someway with the Glasgow and Ayr Company, which effected, I have a very favourable opinion of the ultimate success and utility of Ardrossan harbour.

JAMES WALKER.

No. 395.

Extracts from a Report by Messrs. GRAINGER and MILLER, *relative to the Expense of opening the Docks either as proposed by* Mr. WALKER *or* Mr. MILLER, *and of a New Wharf, &c.*

December 9, 1839.

No. 395.
Extracts from Grainger and Miller's Report on the Expense of forming proposed Docks.

As arranged with Mr. Walker, and as instructed by you, we have made a survey and plan of the present state of Ardrossan harbour. A tracing from this plan is herewith sent. You will observe that in it we have laid down, 1st, the proposed work necessary to complete the breakwater or outer works of the harbour; 2ndly, a proposed wooden wharf on the inside of the breakwater, &c.

In submitting the plan with these various works laid down upon it, it will be necessary for us—with the view to giving the requisite information, shortly to describe them. In so doing we will adhere to the order in which they have been already stated, and commence with first the *Breakwater*.

In our Mr. Miller's letter to you of the 15th July last, he fully described the nature of the proposed work, and subsequently we drew out plans and specifications with the view to the work being commenced. The present breakwater seems to be very frequently giving way, and is altogether in an insecure state. It must be obvious that the existence of the inner works of the harbour depend very much on the security of this work, hence the importance of having it executed in a sufficient and permanent manner. The form laid down on the plan is, we think, sufficient to effect this, and if the breakwater is so completed it will very much screen the whole of the inner works, and to a greater extent than they are at present. The breakwater in the situation laid down is incomplete without a screen wall being carried along the top; accordingly, we propose that a screen wall should be carried along and terminated with a round tower at the point. The top of this screen will stand 20 feet above the level of high-water mark, and it will intercept the higher seas running in the direction of the breakwater. In heavy storms some seas may run over its top, and so as to make them as little injurious as possible, we purpose that the whole of the wharf ground on the inside of the wall should be pitched with stone, and that instead of a perpendicular quay wall, the ground should be terminated with a bulwark sloping down at a moderate rate into the water. This bulwark, although we think it will be the best mode of finishing the breakwater on the inner side, is not of itself suited for vessels coming alongside. To obviate this objection, and to make the line of it available as berthing for vessels, we propose the second work mentioned, viz., *The Wooden Wharf.*

You will observe from the plan that this wharf is laid down to run in a line with the present quay wall there. The wharf is to be 150 feet long, and at it there will be a depth at low water of from 8 to 9 feet. The great advantage of this wharf will be in securing the steam-vessels a quiet berth at all times. The present steam-boat berth is very much exposed to a north or north-west wind, and is therefore uncomfortable in these winds. The proposed wharf would obviate this, and it will afford water almost as deep as the present one, and sufficient for ordinary steam-vessels at all times of the tide. We examined the present harbour to ascertain if a berth for steam-vessels could not be got in it so as to do away with the inconvenience arising from the exposure of the present one; but we found that the harbour is already so much occupied with vessels in the coal and general trade that a berth for steam-vessels could not be spared off it. And again to deepen the harbour further in, so as to make up the space to the general trade which would be taken off, would be both troublesome and expensive, inasmuch as the deepening would have to be carried on amidst the crowding of the vessels, and the quay walls are not founded to admit of being deepened. On the whole, therefore, it occurs to us that a wooden wharf on the inside of the breakwater, sheltered from all heavy seas, is the best mode of remedying the inconvenience arising from the frequent exposure of the present berth. In connection with this wharf, we propose that the rock lying along the foot of the quay wall immediately adjoining should be removed so as to give a uniform depth of water along it and the wooden wharf.

The removal of this rock will afford great convenience to vessels about to enter the dock. {Vessels waiting for this could be brought up alongside of the quay instead of remaining in the fairway of the lock; and the quay being so cleared out, would afford some berthage to both steam-vessels and other craft. Indeed, we have little doubt that the removal of this rock formed a part of the original scheme in regard to the wet dock.

As to the 3rd work &c. &c.

We are, &c.,
GRAINGER and MILLER.

No. 396.

Report by JOHN MOFFAT, Esq., C.E., *on the Capabilities of the Harbour after completion of Works in progress.*

MY LORD, *August* 12, 1844.

No. 396.
Moffat, on the capabilities of the Harbour after completion of Works in Progress.

IN compliance with your request, I beg to forward you the following short statement of the accommodation which the harbour of Ardrossan will afford, when the works at present constructing are completed; and also a description of the deep-water extensions, the plans for which I lately showed to your Lordship.

In March, 1845, when the wet dock is to be opened,* there will be 600 feet of quay wall in 21 feet of water, and 1000 feet in depth, varying from 20 to 10 feet at high-water spring tides. The wet dock will be nearly $3\frac{3}{4}$ acres in area, with 1,560 feet of dock wall in 22 feet water at spring tides, and 19 feet at neap tides. This dock will accommodate forty square rigged vessels, and the two tidal

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* This dock is now opened, and the other improvements connected with it are being finished.

APPENDIX C.

ARDROSSAN.

No. 396.
Moffat, on the capabilities of the Harbour after completion of Works in progress.

basins will together accommodate eighty vessels of the classes at present frequenting the harbour, and to all these quay and dock walls there will be a communication by the Ardrossan Railway.

The extensions of the present piers, which, though not yet contracted for, form part of the plans on which the present contract is founded, will give 500 feet of quay wall in 22 feet water, and 360 feet in 28 feet water. This last extension is obtained by carrying the outer breakwater into deeper water in a direction nearly due north. This work will not only furnish additional quay accommodation, but will also be of great service to the port, by allowing loaded vessels to enter at all times of the tide. It will also completely cover the steam-boat quay, which is at present slightly exposed in strong north-west gales. The depth at the head of this new pier, would be 20 feet at low water.

For repairing vessels there will be a graving dock in 14 feet water, of dimensions sufficient to take in the largest ship belonging to the Clyde, and a patent slip, which can take on two vessels of 800 tons register each. These and the slips for building new vessels, will all be inside the wet dock, and on this account will possess great advantages over all the graving docks and slips from Ayr to Glasgow, which are exposed to the tide and the swell of the sea.

The harbour, when completed in terms of the present contract, will afford ample accommation for the whole traffic in coal, iron, timber, &c., which will be shipped to and from Ardrossan, when the various works in the neighbourhood now in course of construction shall be completed, and also for the traffic in passengers and general goods between the west of Scotland and England and Ireland, which will be carried by the new steamers to Fleetwood, Belfast, and Londonderry. This trade when fairly developed, I would estimate at 100,000 tons of iron, 60,000 tons of coal, 10,000 tons of timber, 50,000 tons of general goods, and 80,000 passengers.

The new harbour for which I have prepared plans would be of far greater extent, and would accommodate a traffic differing greatly both in its nature and amount from that already described. Before describing these works, it may be useful to recall to your Lordship's recollection the objects originally contemplated by the promoters of Ardrossan harbour, and the plans which were proposed for its completion. I am aware that the magnitude of the works I recommend may seem utterly disproportioned to the trade which may reasonably be expected, but a comparison of these works with those first recommended will tend greatly to dispel this impression, bearing in mind the very great increase which has taken place in the trade and manufactures of the country within the last thirty years.

In 1800 the rapidly improving commerce of Scotland rendered necessary increased harbour accommodation, and new modes of conveyance from the coast to the interior. Various schemes were then brought forward for connecting Edinburgh, Glasgow, and Paisley by means of canals, with a large harbour, to be constructed on the Ayrshire coast, at the mouth of the Firth of Clyde. The purposes which the projectors of these undertakings had in view seem to have been the concentration of the whole American and West Indian trade in the Clyde, and of the Baltic and Russian trade in the Forth, with cheap and easy connections, by canal, of these two estuaries with each other, and with the interior of the country. All the eminent engineers of that period; Rennie, Telford, Jessop, Baird, Stevenson, &c., were consulted, and reported on these schemes; and though differing in opinion on many points, they all agreed in recommending Ardrossan as the point on the west coast best fitted for constructing a harbour of the dimensions proposed.

In 1805 Acts were obtained for constructing a harbour at Ardrossan, and a canal from this harbour to Glasgow, by Paisley and Johnston, according to the plans of Mr. Telford. Had these two undertakings been carried on properly they would have been completed in 1808, and Ardrossan would undoubtedly have secured the greatest portion of the trade now divided between Greenock and the Broomielaw. The works were carried on so slowly that in 1811 they were not half finished, and in that year further delay was caused by some difference of opinion regarding the best mode of constructing deep-water piers. Mr. Rennie was called upon to report on this subject. His first report was to the Treasury, in relation to the elegibility of Ardrossan as a Government station for frigates and transports, in which he proposed new piers, &c., different from those recommended by Telford. In 1813 he was appointed engineer to the harbour, and the works were proceeded with under his charge. Shortly after this the commercial depression consequent on the conclusion of the war, and threatened re-adjustment of the currency, had such an effect upon the harbour and canal companies, that they stopped the works. The harbour works were carried on with some spirit by the late Lord Eglinton, with concurrence of the other shareholders, until his death in 1819, when further progress was stopped on account of a want of funds. The alterations effected between 1819 and 1840 were of such a trifling nature, that the chart prepared by Captain Robinson in 1840 may be regarded as containing an accurate plan of the works as they were in 1819. To show the works at this date, I send your Lordship a copy of this chart, marked No. 1.; a second marked No. 2, shows, in red, the additions proposed by Telford and Jessop; a third copy, No. 3, shows Rennie's designs; No. 4 shows Walker's; and that marked No. 5 shows my northern extension. A plan on the same scale contains the southern extension. The cost of Telford's completion would have been about 70,000*l.*; Rennie's 100,000*l.*; Walker's 40,000*l.*, and I estimate the extension to the north to cost 160,000*l.*, and that to the south, towards Saltcoats, 180,000*l.*

The plans of Telford and Rennie are liable to two objections. Their wet docks, though well laid out for communicating with the proposed canal, would be nearly useless for direct communication with the present railway. And by too great an anxiety to keep their outer basins under the lee of the Horse Island in north-west gales, they have run their main piers among the Crinan Rocks in such a way as to obtain a bad entrance, and very indifferent anchorage ground. In the report by Rennie and Whidbey, presented to the Lords of the Treasury, it is justly objected to Telford's pier, that "it shuts up the best entrance into the bay, and that it would be difficult for a vessel to work out to sea in westerly gales." And it seems to me that this applies with nearly equal force to Rennie's own design: A vessel running into the harbour, in a south west gale, would probably throw out her anchor the moment she had rounded the pier-head, and was in smooth water; and supposing her to enter at night, she would run some danger of getting foul of one the Crinan Rocks in swinging too. But, leaving all nautical questions out of view, it seems to me that the impossibility of laying out practicable curves from the present railway station to the dock and quay walls of either of these plans, forms an insuperable objection to both. The harbour and railway must be worked in connection, and Ardrossan would suffer a great loss if the trains could not be taken alongside every vessel in the harbour. Mr. Walker's plan need not be alluded to here. His works were intended chiefly to accommodate large steamers, and, as pointed out in my report to your Lordship of January, 1843, this object can

No. 396.
Moffat, on the capabilities of the Harbour after completion of Works in progress.

be attained by the works at present being constructed at a cost only one-third of what Mr. Walker's would have cost.

In laying out the extensions shown in chart No. 5, and plan No. 6, I have endeavoured to enclose the greatest area of water of sufficient depth, by the shortest length of breakwater, which is equivalent to making the expense per acre of the water surface enclosed, a minimum. To effect this, in the first case, a quay wall, in 22 feet at low water, is carried from the termination of the wooden wharf, constructed in 1839, round the point of the present breakwater, to a point near to the Eagle Crag. From this point it is carried in a westerly direction to a distance of 420 yards, where the outer breakwater commences. Along the greater part of this pier the rock rises at a sharp angle from an average depth of 23 feet at low water, to the level of half tide, so that the masonry and a little filling up behind would alone be required to obtain 900 yards of deep-water pier. The breakwater commences at the west end of this pier, and runs due north by compass for a distance of 780 yards, where it would be terminated by a tower 50 feet high, with a red guiding light. A similar tower and light would be erected on the Crinan Rock. The outer slope of this breakwater I would propose to be from 1½ to 1 from the bottom to low-water level, to which height the stones might be thrown in promiscuously and allowed to find their own place. Above low water the slope should be curved, and the stones pitched to a height of 20 feet above low water. The slope at low water should be 4 to 1, diminishing to 2 to 1 at the height of 20 feet. The top would require to be 30 feet broad, and the inner slope 1¼ to 1, the stones being pitched from the top to low water. The depth of water, at low water, along the line of this breakwater, would be 32 feet on an average, and a channel 30 feet deep and 30 yards wide would be left between the tower and the Horse Island. A tower would have to be built on the extremity of the Horse Island shelves, to mark out the deep water channel, which might be connected to the island by a mound of stone.

These works would defend the bay from all winds, except those from north and north by west. During a gale in these directions a sea would set into the bay from the Cumbraes, and to shut out this I would connect the island to the mainland at Bornfoot by a third breakwater. The two tidal currents round the island meet on the site of this breakwater and form a bar on which there is now only 6 feet water, and which will soon silt up. This work being in such shallow water would cost little, and besides making the bay completely landlocked, would prevent the flow of sand from the north, and would render the whole of the Horse Island available for ship-building yards and iron foundries. There would thus be enclosed an area of about 500 acres, one-half of which would be from 30 to 45 feet deep at high water, the whole completely protected from every wind, and capable of allowing a vessel of the largest class to go in and out in any wind and at any time of the tide.

The materials for constructing the breakwaters at the Horse Island could be had on the island itself; and the stone for the other works could be got from the rocks outside of the sea wall already built. These rocks consist of sandstone, arenaceous limestone, and a curious variety of trap intermediate between basalt and serpentine. The sandstone and limestone could be used for the inside of the piers and breakwater and the trap rock for the external facing. The whole area coloured blue, and marked "Wet Dock," would require to be excavated to a depth of 25 feet below low water, to furnish the necessary quantity of materials. The faces of this excavation being hammer-dressed to the requisite batter wall of Ashlar, built all round to raise them to the necessary level above high water, and a lock 300 feet long, 60 feet wide, with three locking gates and one storm gate, being then constructed, communicating with the outer harbour, a wet dock of 25 acres in extent would be obtained for a very small additional outlay. This dock would accommodate 200 square rigged vessels.

The work would be commenced by excavating the whole of the "*inches*" to the depth specified. The inches are about 6 acres in area, their surface is 6 feet above high water, and they are composed of trap rock. With the materials first got from the excavation, a road would be formed to the Eagle Rock. Inside of this road or embankment a puddle dam would be formed enclosing about ten acres of the stratified rocks; the clay for which dam could be had on the present harbour grounds or from the shore towards Bornfoot. When this space was enclosed, the excavation could be proceeded with on it and the inches, and the breakwater carried as far to the north as would cover the point of the present breakwater where the new deep-water quay begins. This pier could then be begun and carried to the entrance of the proposed lock; after which, a puddle dam behind this pier, adjoining the one first made, could be constructed so as to enclose the remaining nine acres of the lock. The excavation could then be completed, the lock and dock walls built, while the remainder of the breakwater was being executed. While these operations were going forward the breakwater at the Horse Island could be constructed. By proceeding with so many of the works simultaneously the whole could be completed in three years.

Harbour and dock accommodation to an equal extent could be obtained by inclosing the bay between Ardrossan and Saltcoats, and with better railway communication, plan No. 6 shows how this can be effected which is as follows:—A deviation from the present line of railway is made about half a mile to the east of Saltcoats station, and a new line of railway is formed across the head of Saltcoats harbour past the salt pans and across the bay by an embankment to the baths at Ardrossan. There would thus be cut off a space of 70 acres, which could be made into a dock, with an entrance lock 60 feet wide, as shown on the plan. On each side of this embankment, a wall of Ashlar masonry would be built; that on the inside being puddled would be the dock wall, and that on the outside a quay wall. This quay wall would be covered by a breakwater similar to the one already described, which would be constructed in the position shown on the plan in 30 feet water at low-water spring tides. There would thus be obtained a wet dock of 70 acres, and an entrance basin of 100 acres for somewhere about the sum previously mentioned. The advantages of this plan over the first are principally a better and shorter railway, and more easy communication of the railway trains with vessels in the dock or harbour. The present railway from Saltcoats has some sharp curves and two level crossings, and will be found very much in the way when the town comes to be extended. The new line is free from these objections, and is 800 yards shorter than the old. This harbour would also be much better fitted for an extensive steam-boat trade, as passengers coming up the Clyde by steamers to Ardrossan would save half an hour in proceeding to Glasgow, by both steamer and train having a shorter distance to travel over. If the quay and dock walls should be found insufficient to accommodate the trade, projecting piers, as shown by the dotted red lines, could be built in the harbour and dock, with such curves as would allow the trains to be taken to their extremities. The lock would be crossed by a swivel bridge, to allow the trains to proceed to the present harbour. The shore from Saltcoats to Ardrossan, inside the dock, could be advantageously disposed of for ship building-yards, and works of

APPENDIX C.

ARDROSSAN.

No. 396.
Moffat, on the capabilities of the Harbour after completion of Works in progress.

various kinds. The details of construction of these works need not be entered into as their execution would require the consent of the railway company, and the trustees of Saltcoats harbour, failing which a new Act would have to be obtained. Were the Saltcoats trustees consenting, perhaps a better outer harbour than that on the plan would be obtained, by running a breakwater from the north point of Saltcoats harbour towards Campbell's Rock, thus making the entrance between the breakwater-head and Castle Crags.

Having thus pointed out how such a large amount of harbour accommodation could be had, and its expense, it is necessary, in the next place, to determine the probable return upon the capital required for the execution of the works. This return must be to a great extent conjectural, seeing that it will arise from a new direction being given to existing traffic. An engineering report is not the place for discussing this question, so that its leading outlines can merely be glanced at.

When the Glasgow and Edinburgh and Ayrshire Railways shall be joined by the Glasgow Junction Railway, there will be uninterrupted communication from these cities to Ardrossan by railway in the manner proposed by the canal companies. And there can be no doubt but that if the accommodation at Ardossan were extensive enough, the whole of the traffic calculated on by the harbour company when their Act was obtained would flow to Ardrossan. At the present railway rates the expense of taking a cargo from Ardrossan to Glasgow is covered by the excess of dues exigeable upon the ship and cargo in going from Ardrossan to Greenock or the Broomielaw over the harbour rates exacted at Ardrossan, so that there would be a difference in favour of Ardrossan of the seamen's wages, wear, tear, and risk to ship and cargo in going up the Clyde. This saving would be most felt on large vessels engaged in the carrying trade between America, the West Indies, and Glasgow, and these vessels would soon be drawn to Ardrossan. The cargoes of such vessels are generally warehoused in Glasgow for a considerable period. The expense of warehousing would be greatly smaller at Ardrossan than at Glasgow, which would have a further influence in bringing trade to Ardrossan. A still greater saving would be effected on cargoes from America to Leith, Dundee, and Aberdeen, when the Dundee and Aberdeen Railways shall be completed. The enormous expense incurred in constructing the Caledonian Canal is sufficient proof of the delay and danger caused by making the voyage round the north of Scotland. At present the expense of land carriage is so great that the trade can be as economically conducted by sending vessels direct from these ports as by bringing them from Glasgow and sending the cargoes across the country. But the case will be greatly altered when the railway system of Scotland shall be completed, and large deep-water harbour constructed, with low dues, and ample accommodation of every description, communicating with all the trunk lines of the country. Liverpool is one of the best instances of the effect of cheap and extensive communication inland from a large harbour in a favourable position. By the end of last century a network of canals was constructed connecting all the large towns in England, Leeds, Hull, London, Bristol, &c., with Liverpool, and contemporaneously extensive docks were constructed there. In a very short time Liverpool had monopolized almost the whole trade between America and England. The merchants of Liverpool have gone on extending their docks and taking advantage of every improvement in the internal communication of England, so as to secure their pre-eminence in this trade. They were the first to perceive the advantages of railways, and have been most energetic in spreading them in every direction from Liverpool as a centre. The same effect that has taken place in the case of Liverpool would take place with regard to Ardrossan or any other port holding out the same advantages of ample harbour accommodation, and a cheap and expeditious conveyance thence to all the great cities of the country.

An indirect source of revenue was looked for by the original promoters of the harbour, from Ardrossan being made a Government station for frigates, transports, and mail packets. General Tatham, Lord Cathcart, General Dirom, Mr. Rennie, and others, have reported to the Treasury in the strongest terms in favour of Ardrossan as a Government station, provided the deep-water piers were executed. The advantages which the new harbour would place at the disposal of Government in these respects, and the equivalent to be given for them, would require to be discussed in a separate report, which would also take up the questions of the benefit to the public as a harbour of refuge, and the rates to be charged upon vessels entering it for shelter alone.

But by far the largest source of revenue to Ardrossan harbour is to be found in the rising manufactures of Ayrshire. Within the last few years it has been discovered that Ayrshire, in addition to its valuable seams of coal, possesses beds of blackband ironstone of great extent, and of the finest quality. Already two works for smelting are in full operation, and two more are being erected. Now these works will not only give rise to a great trade in shipping pig iron to England and the continent, but they will also have the effect of drawing a large capital into the district for the erection of spinning mills, iron foundries, &c. It has been invariably found that districts possessing an ample supply of coal and iron, and also favoured with natural facilities for the transmission and transportation of goods, have become the centres of a great manufacturing population. Thus Glasgow and Paisley owe their prosperity to the mineral wealth of Lanarkshire; Manchester, Preston, and Bolton to the mines of Lancashire; and the same results will undoubtedly follow the opening up of the mineral fields of Ayrshire. Mills of various kinds are already being erected along the line of the Glasgow and Ayr Railway; and they will rapidly increase in number and size if the country continue prosperous for a few years. Now, to accommodate the trade thus brought into existence, a large harbour must be made at some point on the Ayrshire coast; and there is not one place along the coast where harbour works could be constructed that could for a moment be compared with those I have described, in point of security, ease of access, and cheapness of construction.

I have not the data necessary for making an accurate estimate of the traffic that would in these various ways be brought to Ardrossan. No doubt it would be very large; but before beginning any of these new works, its amount would require to be ascertained, in order to determine how far, and at what rate, the piers, &c. ought to be carried on.

Besides the revenue that would accrue to your Lordship as harbour proprietor, very large returns would be obtained indirectly from the increased value that would be given to the barony of Ardrossan, and to the minerals under it, and the Eglinton estates at Kilwinning. All these points, however, connected with the revenue, are foreign to the engineering part of the question, and would require to be reported upon by your Lordship's land agent, with the assistance of persons practically acquainted with the different kinds of traffic I have alluded to.

I have, &c.,
JOHN MOFFAT.

The Right Hon. the Earl of Eglinton.

APPENDIX C.

ARDROSSAN.

No. 397.
Income and Expenditure.

No. 397.

Return of Income and Expenditure for the Years 1842–3–4.

INCOME.

Heads of Income.	1842			1843			1844		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Harbour and anchorage dues . . .	371	6	5½	333	10	5½	407	1	5
Tonage dues . .	409	11	4¾	363	14	8	450	4	9½
Crane dues and wharfage	74	19	1½		..			..	
Miscellaneous . .		..		5	0	0	5	7	6
Total . . £.	855	16	11¾	702	5	1¼	862	13	8½

EXPENDITURE.

Heads of Expenditure.	1842			1843			1844		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Salaries and wages .	84	16	6	173	7	7	160	17	9
Repairs to breakwater	240	8	5½	71	11	8		..	
New boiler for engine, hawser, &c. . . .		..		113	14	6		..	
Labour and materials	326	7	9	231	8	5½	322	16	9¼
Turn table, loading machine, and steel yard	168	2	2		..			..	
Harbour roads . .	18	0	0	6	8	8	2	11	2
Lighting and repairs	105	15	9½	149	11	6	131	7	1½
Reports	18	18	6		..			..	
Printing and Advertisements . . .	10	12	7	3	13	2	1	18	0
Sundries	9	6	2	53	5	3½	89	18	2
Total . . £.	982	7	11	803	0	10	709	8	11¾

Dues levied under the authority of the Act 5 Vic., c. 62. The Income is exclusive of the following sums paid for rents of houses to Lord Eglinton's trustees as proprietors, and which were not levied under the Act, viz., 1842, 38*l*. 12*s*. 4½*d*.; 1843, 80*l*. 15*s*. 9*d*.; 1844, 65*l*. 0*s*. 4*d*.

GEORGE JOHNSTON, *Treasurer*.

SALTCOATS.

No. 398.

Return to Order of the House of Commons of August 9, 1844.

SALTCOATS.

No. 398.
Return to Order of the House of Commons of 9th Aug., 1844.

Sea Bank, February 18, 1845.

ROBERT CUNINGHAME, of Auchenharvie, my great-great-grandfather, about the years 1683-84, &c., built the quay or pier, and formed the harbour of Saltcoats, as it at present remains, with some improvements, at his own personal expense.

In the year 1686 there was an Act passed in the Scottish Parliament (taken from the Acts of the Parliaments of Scotland, vol. viii. page 609), in the reign of James the Seventh, intituled "Act in favours of Robert Cuninghame, of Auchinharvie, for uplifting an Imposition on Beer and Aile, for building ane Harbour at Saltcoats." This Act recites, "Understanding how profitable and usefull ane harbour at Saltcoats, within the pariochins of Stevenson and Ardrossan, bailiary of Cuningham and sherifdoom of Air, as well to strangers as those of the kingdom, and for exporting the native commodities of that countrey, and especialy coall and salt, wherewith it abounds; and that Robert Cuningham of Auchinhervie hath already employed, and is to employ, much money and charges for building of ye said harbour; and that ane small imposition upon the aill and beer broun and vended within these parochins, and which for the most pairt is bought and drunk by those who come to and goe from the harbour, may in some measur repair the said Robert of his expenses of the said building," &c. The Act goes on to grant an imposition of four pennies Scots upon each pint of ale and beer, to be uplifted by the said Robert Cuninghame, his heirs and successors, for the space of twenty-one years.

Another Act of the Scottish Parliament, of 7th June, 1693, in the reign of William and Mary, intituled "Act explanatory in favors of Robert Cuninghame of Auchenharvie, for perfecting ane Harbour at Saltcoats," recites the former Act, and goes on to state, "And being fully satisfied that the said Robert has, in prosecuting that publick weall, greatly prejudged his private fortune, and that it will be much the interest of that place in respect of trade the samen be perfected, their majesties' revenue of excyse being, when the said Robert began the said harbour, only fifty-two pound Scots quarterly, and now, by his industry, raised to ane hundred and seventeen pounds quarterly." It then ratifies and approves the foresaid Act, and grants to Robert Cuninghame the right of excise on all beer, brandy, &c., already imposed, he paying out of the same the sum of one hundred and seventeen pounds Scots quarterly.

It does not appear that the harbour has ever been a source of profit to the Auchenharvie family. As stated in the Act above recited, the advantages thereby, and by the subsequent Act, only in a small degree repaired the outlay.

In a petition presented to the Estates of Parliament in Scotland on the 25th of March, 1707, it is stated, as the ground of asking further aid, "yet your petitioner (James Cuninghame, son of Robert Cuninghame), albeit his father nor he be no ways reembursed of the expenses in building the said harbour," &c.

Subsequently to this period the harbour was maintained solely at the expense of the Auchenharvie family, except from the old duties, down to the year 1797, when the first Act of Parliament authorising rates to be levied was obtained. In that Act my father associated with himself certain gentlemen therein named, as trustees for repairing and improving the harbour.

By this Act certain rates and duties were granted, which were thereby directed to be applied "in extending and enlarging, repairing, scouring, deepening, and improving the said harbour, the piers, wharf, walls, and quays thereof, and in supporting, repairing, and keeping the same in repair, and in repaying such sums of money as the said trustees may find necessary to borrow, in manner after mentioned," &c. The endurance of this Act was for twenty-one years from 5th July, 1797, intituled, "An Act for enlarging, deepening, improving, and maintaining the Harbour of Saltcoats in the County of Ayr." It was found, however, in carrying this Act into execution, that money could not be borrowed on the credit of the revenue, which was insufficient as a security; and when

APPENDIX C.

SALTCOATS.

No. 398.
Return to Order of the House of Commons of 9th Aug. 1844.

it became necessary to raise a sum to be expended in carrying into effect certain indispensable repairs and improvements, my father and myself were obliged to do this on our own personal credit.

At the date of the expiry of the Act of 1797 the harbour trustees were considerably in debt to me on account of these recent advances made by my father and myself.

The next Act, also for twenty-one years, 1 and 2 Geo. IV. c. 98, passed on 8th June, 1821, from its date, and from thence to the end of the then next session of Parliament. This Act recites, "that a considerable sum of money has been expended in enlarging, deepening, and improving the same, part of which remains as a debt upon the said harbour; and whereas Robert Cuninghame of Auchenharvie, Esquire, the proprietor of the said harbour of Saltcoats, is liable for the amount of the debt so owing upon the said harbour."

By this Act certain gentlemen therein named were appointed trustees along with me for the management of the harbour, and certain increased tonnage-duties on vessels and rates on goods were granted. The trustees were authorised, as in the former Act, "from time to time to borrow and take up at interest any sum or sums of money, provided the interest to be borrowed do not exceed one-half of the annual produce of the net duties by this Act given and granted, taken upon an average of the three last years, and to grant, assign, and set over the said duties, or a sufficient proportion thereof, to any person or persons whatsoever who shall be willing to advance and lend money thereon, for securing the payment of the same, with interest respectively."

This clause, as to borrowing money on the credit of the rates and duties, was under this Act, as it had been in the former, found to be totally inoperative, the revenue of the harbour not affording a sufficient surplus whereon to raise money for its improvement; when I was under the necessity of advancing the money myself. This Act is intituled "An Act for more effectually enlarging, deepening, improving, and maintaining the Harbour of Saltcoats in the County of Ayr."

The present Act, anno sexto et septimo Victoriæ Reginæ, cap. 45, "An Act for further improving and maintaining the Harbour of Saltcoats in the County of Ayr," passed 27th June, 1843. This Act is also for twenty-one years, with trustees, with power to borrow money to the extent of six thousand pounds, but which must be quite inoperative, the debt due to me at the commencement of the Act being four thousand one hundred and nineteen pounds eight shillings and seven pence sterling, as recited in said Act, besides the expense of obtaining this Act, the above debt having been contracted since the commencement of the Act of 1797.

I herewith send a copy of a map or plan of the harbour of Saltcoats, drawn from a survey taken in 1841, on one sheet, showing the situation and bearings of the harbour, and of the projected extension and improvement, with its bearings, which would be a great shelter and security to the harbour, particularly with any wind to the south of west. The bearings, as laid down, are—

1st bearing, north entrance to Lamlasb Roadstead . . 88 S.W.
2nd ,, south end of Isle of Arran . . . . 70 S.W.
3rd ,, Ailsa Craig . . . . 56 S.W.
4th ,, of buoy, where an anchor is laid for warping out vessels.

From a little way on the outside of the Inner Nebbock Rock, or at the buoy, vessels can stand out to the south or south-east, and are in the open sea in deep water at once, with no sunk rocks, or any other interruption.

I send also on another sheet—

1st, A section plan of the proposed erection on Inner Nebbock Rock.
2nd, A sketch of the proposed erection, with the end turned round into the deep water.
3rd, Another sketch of the proposed erection, more confined to the rock.
4th, An elevation sketch of the erection, as finished, and specifications.

It would have been most desirable and advantageous to all the people of the place and neighbourhood, and all shipping frequenting the harbour, could this improvement be made; and it was attended with much regret when it was found that it must be abandoned from want of the necessary funds to accomplish the work: the estimate was about five thousand pounds sterling, but even less would form a breakwater alone. There has been a good deal done in deepening the harbour by dredging and taking out stones and clay, which had been never touched before, making the depth of water now in the harbour upwards of 13 feet in spring tides.

ROBERT CUNINGHAME, of Auchenharvie.

No. 399.

Specification for a proposed Improvement upon the outer end of the Pier of Saltcoats Harbour.

No. 399.
Specification for proposed Improvement of Saltcoats Harbour.

Saltcoats, 1841.

THE mason-work of the new pier to be built of the best description of sandstone block, of large dimensions, as will be described.

The foundation of the breast-wall and pier-head to be cleared away, by means of a diving-bell, to the depth of 2 feet under the present bed of the harbour, provided the bottom consist of sand and mud; but if the bottom consist of till or clay, 12 inches below the present bed will be sufficient to secure a good foundation.

The mason-work under low-water mark upon the breast-wall and end of the pier to be of large blocks, well squared, and dressed on beds and joints; the heads to be hammered or picked to the level of the wall; the tail to be left in the state it came from the quarry.

Each stone not to be less than from 8 feet 6 inches to 7 feet 6 inches in length, and from 2 feet 3 inches to 4 feet in breadth, and from 1 foot 6 inches to 2 feet in thickness.

The two courses under low-water mark, at back side of the pier, upon the round, to be dovetailed, as will be described upon the working drawing.

All the masonry above low-water mark to be built of hewn sandstone of good quality, and lain in regular courses, from 12 to 24 inches, dressed on beds and joints; the heads to have margin-drafts round the heads, and to be picked or broched off betwixt the drafts; the courses to consist of stones laid header and stretcher alternately; the header not to be less than 4 feet 6 inches in length; the stretcher not to be less than from 2 feet 9 inches to 3 feet in breadth of head, and from 3 feet to

APPENDIX C.

SALTCOATS.

No. 399.
Specification for proposed improvement of Saltcoats Harbour.

6 feet in length, and to be backed up with large blocks of hammer-dressed rubble, to correspond with the height of the courses; the breast-wall and pier-head to be carried up to the level of the present quay-wall, and to be coped with a course of stones 3 feet 6 inches in breadth and 1 foot 8 inches in thickness, well squared and dressed, and rounded upon the head, as shown upon the drawing.

The foundation of the back or sea-wall to be cut out of the rock, as shown upon the section A; the first course to vary according to suit the rock. Each stone not to be less than 3 feet in the bed, and well secured into the rock. All the upper courses to be carried up to correspond with the dimensions shown upon the drawing, to the height of 6 inches above the level of the coping of the breast-wall, where the parapet-wall will commence. All the mason-work up to that level will be bedded with Arden cement to the distance of 9 inches back from the front of both beds and joints, and pointed outside with Roman cement. All the back side of the walls to be laid in good mortar, made up of good Scotch lime and sharp sand, free from all earth, all packed and grouted solid.

The interior of the pier to be filled up with small shivers and with good large rubble, closely packed together and filled up to within 15 inches of the top of the cope, when the whole upper surface will be levelled and packed up with small shivers and the refuse of the lime, to prepare a bed for the pavement, which is to consist of well-squared blocks, both joints and ends, and rough-picked upon the top, and laid in regular courses in a good bed of common mortar; the courses to run from the coping to the parapet-wall.

The parapet-wall to be built to conform with the drawing, to be 9 feet thick at the bottom, and 2 feet 6 inches at the cope, to batter up from the bottom with four courses of hewn steps, not less than 2 feet on the beds, and from 2 feet to 6 feet in length; the three first steps to have 9 inches of tread, the fourth or upper step to have 14 inches of tread, as shown upon the section; the cope of the parapet to be of one stone in breadth, rounded off on back and front, as shown; and all the masonry of the parapet to be built and laid in the same manner as the breast and back wall.

The whole of the work to be executed to the entire satisfaction of whoever may be appointed by the directors to superintend the same.

The back of the pier-head to be opened out so as to join the new masonry, as shown upon the drawing; and a stair to be erected upon the inside angle; each step to be 3 feet long and 9 inches of tread, neatly fitted into the old breast-wall.

No. 400.

Return of Income and Expenditure for the Years 1841–2, 1842–3, 1843–4.

No. 400.
Income and Expenditure.

INCOME.										EXPENDITURE.									
Heads of Income.	1841–2.			1842–3.			1843–4.			Heads of Expenditure.	1841–2			1842–3.			1843–4.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Old dues . . .	57	12	8½	38	4	5	56	19	11½	Harbour-master and clerk's salary . .	30	0	0	22	10	0	35	5	0
New dues . . .	176	3	3½	86	10	0	135	3	3	Dredging harbour .	148	15	1½	..			43	19	0
Dues on goods . .	9	19	4	6	0	5	14	3	0	Materials for harbour, tradesmen's account, & labourer's wages . . .	71	18	6	34	9	5	26	0	3½
Gas lamps and plank for quay . . .	35	3	3¾	15	15	0	25	4	1½	Lighting . . .	17	18	1	8	16	3	12	17	9
										Rent of offices . .	1	0	0	3	0	0	4	4	0
										Harbour-master's expenses to London (re. the new Act).	..			..			23	14	7
										Composition for old harbour dues . .	..			18	15	0	25	0	0
Total . . £.	278	18	7¾	146	9	10	231	10	4	Total . . £.	269	11	8½	87	10	8	171	0	7½

Dues levied under the authority of the Acts passed in 1797 and 1821, 6 and 7 Vic., c. 45, in 1843.

ROBERT CUNINGHAME.

Debt due on the 1st of January, 1846, 5,292*l*.

IRVINE.

No. 401.

Return to Order of the House of Commons of August 9, 1844.

IRVINE.

No. 401.
Return to Order of the House of Commons of 9th Aug. 1844.

SIR,

Irvine, March 31, 1845.

IN reference to your circular of date 1st February last, I have the honour to send you herewith—

1st. Plan of Irvine Harbour, by David Smith, Esq., Civil Engineer, Glasgow, 1826.
2d. Report by the said David Smith, dated 13th February, 1826.
3rd. Plan of the Harbour by John Gibb, Esq., Civil Engineer, Aberdeen, 1839.
4th. Report by the said John Gibb, dated 4th October, 1839.

I have further to mention that the Act of Parliament under which the Harbour Trustees now act, and have for nearly twenty years past acted, is intituled "An Act for widening and improving the Bridge of Irvine, for making Streets communicating thereto, and for more effectually enlarging, deepening, improving, and maintaining the Harbour of Irvine, in the County of Ayr." (May 26, 1826.)

I am not aware of any complaints having been made to the Trustees of the defects of the said harbour.

I have, &c.,
JAMES JOHNSTON,
Clerk to the Harbour Trust.

The Hon. H. Manners Sutton.
&c. &c. &c.

IRVINE

No. 402.
Smith, on improving the Harbour, and forming a Dock.

No. 402.

Report by DAVID SMITH, Esq., C.E., *on enlarging and improving the Harbour, and forming a Dock.*

Glasgow, February 13, 1826.

HAVING inspected the harbour at the town of Irvine, with a view to ascertain the most eligible manner of improving and enlarging the same, I am of opinion that great advantages would accrue to the town and to the coasting and general trade of the west country, and particularly to the Irish trade, by an immediate enlargement and repair of the present harbour.

The harbour of Irvine is situated about three-fourths of a mile from the centre of the town, at the confluence of the rivers Irvine and Garnock, and surrounded by hills of shifting sand. In dry windy weather considerable quantities are blown into the harbour, and also large quantities have been carried into it by the flux and reflux of the tide, and sundry banks have been formed in and around the harbour which are daily shifting their positions, and have formed a permanent bar at the mouth of the river, to the great hindrance and injury of the trade at the port. In order to remove and prevent the enlargement of this bar, and the further interruption to the navigation of the river, it appears to me that it will be necessary to procure a dredging machine, fitted with a steam-engine similar in principle to those on the Caledonian Canal, or to the one employed on the river Clyde, and that it be immediately applied to the removal of the bar, in the first instance, from the middle of the river, at low water, and thereafter to be employed in clearing the interruptions of the channel and harbour, and the formations of the sandbanks as they accumulate. The respectable trade of the port of Irvine requires that this be done without delay, as in my opinion that port ranks the second on the west coast of Scotland, and from its local situation will continue rapidly to improve. For, the great increase of the manufactures of the country, and the extensive improvements going forward in Ireland by the establishing of public works, will create an additional demand for coal from Scotland, of which that article is the principal export from the port of Irvine. On the 10th of this present February I found in the harbour no less than 57 large vessels, from 60 to 260 tons, chiefly loaded with coal for Ireland and the Highlands. These vessels had imported to Irvine principally grain, limestone, wood, slate, brick, bark, and whinstone as ballast. Some of these vessels were of 300 tons burden, and have traded to Newfoundland and numerous other ports in America; and from the situation of Irvine to the flourishing town of Kilmarnock, that part of its exports to America may reasonably be expected to increase. Indeed all the features of the county of Ayr, in the neighbourhood of this port, warrant the immediate preparations for an increase of harbour accommodation. This I should propose to be done, in the first instance, by a continuation of the present quay-wall along the water of Irvine, towards the town from A to B on the plan, to the extent of 324 feet at least, which would give great relief to the vessels waiting for loading-berths, by allowing four more vessels to discharge and load than the present accommodation affords. This quay-wall may be extended 440 yards towards the town at pleasure, in the direction of the red lines on the accompanying plan, and is by far the least expensive mode of giving extended accommodation to the port. The next method of improving the harbour is by the formation of a wet-dock; and although this is not so easily done as by the foregoing plan, still few places present so favourable a situation for this purpose as is to be found at Irvine; and I would by all means recommend to the Magistrates and Council to take powers in their Act to form the present harbour into a wet-dock by altering the course of the Irvine a little farther to the north, and forming a quay on the north side, which is already nearly filled up by the depositing of ballast from vessels entering the harbour, so that the breast-wall is only to be built along the north side; this wall to be continued along the whole of the north side, and two cross butts or quays with drawbridges to be put in to connect the wharfs on either side; a bank in continuation of the quay to be formed across the bed of the Irvine near the upper end of the present quay-wall, to form a connection with the street; the upper end of the harbour when thus enclosed to be occupied by vessels waiting for cargo, or by others wind-bound, so that the whole quay for loading and discharging may be kept clear for the trade. The west end of the north quay to be continued out from the present perch or pawl, to the extent of about 200 feet, and a lighthouse erected on the point thereof for the use of vessels entering the harbour at night. The want of a lighthouse is at present a great drawback on the port of Irvine, as in stormy weather it is impossible to take the harbour when dark, and vessels arriving in the evening are frequently obliged to run a considerable distance for shelter, or lie at anchorage on the outside of the bar till daylight, which is often attended with damage. I should propose that the extension of this pier or quay should be formed, in the first place, 30 feet wide, of strong wooden posts, driven 6 feet into the clay below the bottom of the harbour, each post to be 6 feet distant from another, and the spaces between them to be filled up with sheating piles, 6 inches thick and closely jointed. The large posts to be of Memel timber, and to be tied across at half height and at the top with a beam of the same kind of wood 7 inches thick and 14 inches broad, bolted at both ends, and the space filled up with the stone ballast from Ireland and other places, laid in regular order with the largest stones nearest the wood, and the surface to be raised 2 feet above the level of the present wharf.

The top to be finished with a row of cope-stones 15 inches thick, 2 feet broad, and 3 feet long, and well causewayed in the middle with whinstone 1 foot deep. The continuation of the building of the breast or quay wall, on the north side of the present harbour, to be done with wood and stone, as directed for the pier, but having only one row of large posts in front, and braced backwards to smaller posts, driven into the ground before filling up the ground behind; the side of the quay next the Irvine water to be of stone, with a sloping bank of rough stones, laid so as to defend the quay from injury by the floods in the *river*. The upper dock to be formed for the reception of vessels to undergo repair, and the slip-dock to be removed into it for protection, as the present situation is neither so convenient nor safe as the one proposed to communicate with the harbour. The new quay on the south side to be formed by building a stone breastwork, founded 2 feet below the bottom of the harbour and continued along at the same distance from the present wall, as shown on the plan, and the present wall taken down and the space filled up to widen the wharf. These improvements, I think, would render the harbour of Irvine one of the most convenient and safe ports in the west of Scotland, and for the prosperity and growing trade of the town ought to be proceeded in without delay.

DAVID SMITH

No. 403.

Report by JOHN GIBB, Esq., C.E., *on the best means of improving the Harbour, and Estimate.*

No. 403.
Gibb, on improving the Harbour, and estimate.

GENTLEMEN, *October* 4, 1839.

WHEN I visited your harbour in June last, I carefully considered its position and relative bearings, and also the works which had already been carried into execution under the direction of Mr. Wyllie. I likewise took some soundings, merely to enable me to prepare instructions for a survey, on which I could lay down and describe more accurately what I intended to advise should be carried into execution in furtherance of the object you have in view, viz. to obtain protection and additional depth of water through the entrance.

Having obtained your permission to make the survey, it will be seen, by the accompanying plan and sections, that it has been ably accomplished under the direction of Mr. Miller.

Before proceeding to describe what I have to propose, I shall take the liberty to notice that, in as far as means were placed at his disposal, Mr. Wyllie has carried on his operations judiciously; and, from all I could learn, they have been the means of considerably increasing the depth of water.

The entrance to the harbour is situated on a very flat sandy shore, without any natural protection, unless the island of Arran be considered one, but it is distant, I believe, about 14 miles, and, although certainly in some degree has the effect of preventing the ground swell, it affords no real shelter to the entrance to the harbour, which is at present open to the Western Ocean from the south-west; and from the circumstances of the adjacent coast on both sides being composed of shifting sand, it is only from the effect of the reflux of the waters of Irvine and Garnock that the entrance to the harbour is maintained. Without this natural advantage no harbour entrance could be preserved in its position so situated, unless by the construction of works at an expense far beyond what would be prudent or advisable, and for which no adequate remuneration could be expected.

I have therefore, with your desire expressed to me when I had the honour of meeting, confined my views entirely to facility of entrance and departure, improving the protection, and increasing gradually the depth of water into and through the navigation channel, to the existing harbour, at the least possible expense, and with works which may be gradually executed, it is hoped, within the limited means at your command, without at present advising an alteration of the existing accommodation of the interior, for the improvements of which there is certainly great capability.

But until a better entrance and greater depth of water be secured, it would be needless to expend money in the interior, unless for temporary accommodation for the trade.

It will be seen, by examining the accompanying plan and section, that the depths of the navigation channel and the bottom are very irregular; therefore vessels taking the ground must, if heavily loaded, be liable to strain, consequently occasioning much additional tear and wear: besides, if a vessel under such circumstances be outward bound, the consequences become more serious both to lives and property.

It will be seen that the greatest depth of water is where the channel is narrowest, particularly at the transverse sections DE and FG; at the former the depth is 15 feet, and at the latter 8 feet; and where the channel widens and approaches seaward, the depth decreases; and at the extremity, or on section Q R, the depth in the middle of the channel does not exceed 3 feet. Now, as I have already noticed, it is only the reflux of the waters of the Garnock and Irvine that maintains the navigation channel even in its imperfect state, and they can only be efficient when accompanied with land-floods, because their natural waters are comparatively small.

I may also mention that, as the benefit of the scour from these waters can only be useful at the last quarter's ebb, the narrowing of the navigation channel becomes a matter of primary importance. In short, the narrowing of the channel is tantamount to deepening, from the circumstance of those parts where the width is least the water is deepest.

Therefore, in order to accomplish the object in view, I propose to narrow the channel and extend the entrance 300 feet; and then to construct two wooden beacons, for which I have given a plan and section on sheet No. 2; also a separate specification from which they are to be constructed.

These beacons are intended to aid vessels in entering and departing from the harbour, to which a vessel may be fastened, either for shortening sail on entering or waiting the tide, or making sail in departing at all times, when it is practicable to approach them with a boat; by constructing them of open work they will be much easier to approach than if they were of solid building, and at a much less expense; and it is better at all times to elude rather than resist a wave. I have marked their position in *red*, as also the other jetties I propose for narrowing the navigation channel inwards, for which there is also a plan and section on the sheet No. 2. In constructing the latter I propose, in the first place, to drive one main pile, and form a base of rubble-stone all round, as represented in the plan and section, the pile being left sufficiently high, so as not only to mark the line of the channel above high-water, but also to answer the purpose of working a vessel in or out of the harbour. It will be seen by the plan, No. 2, of the two entrance beacons, that I propose to guard the base by a mound of rubble-stone, both as represented of these and the other jetties inwards. But although I have represented these as between 50 and 60 feet in length, it is probable that some of them may be required longer and some of them less: the great object is to confine the reflux of tidal and land water during the last quarter's ebb, when the scour can only be useful, in deepening the channel.

It will be seen by the dotted red line on the plan, that I propose to make the channel at the entrance 258 feet, diminishing to 200 at the root or entrance to quay; and that I also propose to add about 30 feet to the jetty at A, for the purpose of cutting off a portion of the sandbank below C at the quay.

As I am aware that your funds are limited, I should advise in the outset that the two main or outer beacons should be constructed in the first place, and the rubble mounds to connect them with those already done, and that the other jetties represented inward should follow as the means at your command will allow; but the sooner they can all be constructed the sooner you may expect the deepening to take place. It may be proper here to mention, that, although I have laid down the positions of these jetties where I think they will be most beneficial, experience may suggest, after trial, that the position intended to be given to the remainder may be altered so as to produce a greater effect; but this can only be ascertained by experience.

APPENDIX C.

IRVINE.

No. 403.
Gibb, on improving the Harbour, and estimate.

Permit me before concluding this report to say, that, although I have recommended what, after the most careful consideration, I deem best calculated for protecting and deepening the navigation channel, I must at the same time warn you not to expect that the measure I have advised you to adopt will operate like magic, by effecting an immediate deepening; but at the same time I have no hesitation in stating that, if carried into execution, the effect will be gradual and permanent, whereas an immediate deepening can only be accomplished by the aid of powerful dredging machinery, which I apprehend is beyond your reach; and, after all, without narrowing the channel, could not be maintained but at an enormous expense.

I have estimated the whole of the works proposed in the foregoing report at 1250*l.*

To the Magistrates and Town Council of Irvine. JOHN GIBB.

No. 404.
Income and Expenditure.

No. 404.

Return of Income and Expenditure for the Years 1842–3–4.

INCOME.				EXPENDITURE.			
Heads of Income.	1842	1843	1844	Heads of Expenditure.	1842	1843	1844
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Harbour dues and plankage . . .	405 2 11½	353 12 6	407 3 7½	Salaries	81 6 0	77 11 0	66 12 6½
Rents	7 18 6	5 7 6	4 19 7	Maintaining and extending harbour .	372 0 3½	220 18 0	319 13 9½
Weighing machine .	..	..	1 10 1	Repairing quays .	..	134 15 6	..
Sale of stones, &c. .	4 19 8	0 17 5	6 9 6	Making and repairing streets and roads leading to harbour . .	80 6 1	228 6 9½	..
				Repairs of harbour office, &c. . . .	..	..	6 11 1
				Printing and sundries	2 10 10½	6 17 1	13 1 4
				Rates and taxes, and insurance . . .	3 6 1½	3 18 3½	3 6 9
				Expense on loans .	..	10 17 10	..
				Interest	..	18 17 2½	27 11 1
Total . . £.	418 1 1½	359 17 5	420 2 9½	Total . . £.	539 9 4½	702 1 8½	436 16 7

Dues levied under the authority of the Act 3 Geo. IV., c. 91.

NO SIGNATURE.

Debt due on the 1st of January, 1846, 1,072*l.*

TROON.

TROON.

No. 405.

Return to Order of the House of Commons of August 9, 1844.

No. 405.
Return to Order of the House of Commons of 9th Aug. 1844.

SIR, *Harbour Office, Troon, Feb.* 4, 1845.

IN compliance with the order of the House of Commons of 9th of August, 1844, I beg to make the following return:—

"Whereas Her late Majesty Queen Anne, by charter, bearing date the fifth day of August, and sealed at Edinburgh the 10th October, 1707, granted to W. Fullerton, and his heirs, therein mentioned, the port, marine station, and harbour of Troon, therein declared to be a free port, marine station, and harbour, with power to improve, repair, erect, and build the same for receiving all ships, boats, and other vessels, and to levy and apply to their own use the anchorages, and all petty customs, casualties, and duties thereof."

Also an Act of 48 Geo. III., 1808.

"May it therefore please your Majesty, That it may be enacted, and be it enacted, by the King's most excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, that it shall and may be lawful to and for the proprietor or proprietors of the said harbour for the time being, and he, she, and they, is and are hereby authorized and empowered from time to time to erect, construct, make, build, do, maintain, and support such wet-docks, entrances, piers or ramparts, quays, buoys, and such other works as he, she, or they shall deem necessary or expedient for the improvement of the said harbour of Troon, and for the reception and accommodation of ships and vessels lying therein, and for the convenient lading and unlading of such ships and vessels."

A plan of the harbour accompanies this. There are no reports of engineers, or others. No complaints.

His Grace the Duke of Portland is now completing the wet-dock marked in the plan "intended wet-dock," and it will probably be opened by the spring of 1846. The eastern breakwater is also being extended, as shown in red ink, and will be completed by the end of 1845.

I am, &c.,
JOSEPH MAYNARD, *Commander R.N.*

The Hon. H. Manners Sutton,
&c. &c. &c.

No. 406.

Substance of the Answers to 120 *printed Queries circulated by the Tidal Harbours Commission.*

No. 406.
Substance of Answers to Queries.

THE Troon is an artificial, tidal harbour, enclosed by piers, with an entrance between 300 feet in width, facing north-east, and having a depth of 11 feet at low water, and 19 feet at high water, average spring tides. The harbour is the property of the Duke of Portland, who appoints a manager. Dues are levied under the Act of 48 Geo. III. The gross revenue of the port, in 1845, amounted

Appendix C.

Troon.

No. 406.
Substance of Answers to Queries.

to 3992*l*. The arrivals in 1845 were 1281 coasters, of 98,712 tons; foreign, 22 vessels of 5816 tons; belonging to the port, 1400 tons in sailing vessels. Troon has a tidal basin, with an area of 1¼ acres, and an average depth of 20 feet at low water. Two graving docks, the entrances, respectively, 37 feet and 24 feet wide. The extent of wharfage is 4661 feet; there are three cranes, capable of lifting 10 tons each, and one of 2 tons. There are three building slips, and about 100 men are employed in ship building. Supplies of all sorts are abundant; water is led down to the quays, steam coal can be had at 9*s*. 4*d*. per ton, and 500 tons, if required, can be supplied in a day. The eastern breakwater has recently been extended 760 feet. There is one steam dredge of 12-horse power, capable of lifting 200 tons of soil a day, at the cost of 4½*d*. per ton; and by means of this the basin has lately been deepened from 6 feet and 8 feet, to which it had been reduced, to 11 feet in depth at low water.

"Since the commencement of the works at the Troon, a great alteration for the worse has taken place. At that time, at the extremity of the pier, there was from 15 to 17 feet depth of water at low water of ordinary tides, which had been reduced to 6 or 8 feet. Within these few years, however, it has been increased from the lowest depth to which it had been reduced, and as the ebb tide is now excluded by the breakwater, it is hoped that it is not possible for the silt with which it is loaded, to be deposited within the pier, as the still water, which favours the deposit, will always be counteracted by the clear water running out of the inner harbour and the basin, which necessarily must be running out some time after the tide is lowest.

"In answer to the inquiry as to what changes have taken place, it would not be proper to withhold the fact, that the land has gained a great deal on the sea during the last 50 years on this coast. The late Mr. Wilson, manager at the Troon, was a native of Ayr, and he told me that there is now a stone on dry land, off which when a boy he used to jump into deep water—I think he said 12 feet deep. It is impossible that it should be otherwise. The two rivers of Ayr and Doon must be continually discharging sand, &c., into the sea, which cannot fail, in still water, to form a deposit. I should add, what more particularly concerns the Troon, that when there is a great flood in the water of Irvine, its stream may be seen discoloured for 3 or 4 miles to the westward of the bar of Irvine, of which the materials must be deposited at the bottom. I am afraid the remedy for these evils would not be found practicable.

"The piers are built of rubble-stone, faced with granite ashlar. The stones in the northern pier, or breakwater, vary from one to six tons in weight. During the last two years the sum of 28,550*l*. has been expended on harbour improvements, and the whole sum laid out on the harbour has been 250,000*l*. The population of the place was 2148 in 1841; seafaring men about 100. There are six pilots; charges 1*d*. per ton register above 45 tons. One harbour light, intermittent, and lighted with gas. Generally, for the benefit of navigation, I consider that a light on the Lady Isle would be of use, yet much more to the harbour of Irvine than the Troon. Many years ago I proposed to the shipmasters of Irvine to have a light erected on it, and to pay for it by a tax of one farthing per ton on the shipping frequenting the two ports. The proposal was met with no favour."

"Scott Portland."

The country around the Troon abounds in coal and iron; there are good freestone quarries in the neighbourhood, where blocks of from 5 to 6 tons can be procured. The coast is low, and neither it nor the harbour has any military defence whatever, either natural or artificial.

No. 407.

No. 407.
Income and Expenditure.

Return of Income and Expenditure for the Years 1841–2–3.

INCOME.				EXPENDITURE.			
Heads of Income.	1841.	1842.	1843.	Heads of Expenditure.	1841.	1842.	1843.
	£. s. d.	£. s. d.	£. s. d.		£ s. d.	£. s. d.	£. s. d.
Dues on tonnage and imports and exports	931 17 1	809 6 3	839 4 8	Manager's salary.	250 0 0	213 0 0	201 0 0
Dues on coal shipped	2,328 4 0	2,265 10 6	1,846 6 10	Workmen's wages and materials, &c.	6,467 1 5	5,726 6 0	4,505 13 4
Dues for water, ballast, hawsers, &c.	259 13 4	229 2 0	162 3 11				
Rents of houses and stores	71 10 0	143 8 5	166 10 3				
Total . . £.	3,591 4 5	3,447 7 2	3,014 5 8	Total . . £.	6,717 1 5	5,939 6 0	4,706 13 4

Dues levied under the authority of the Act of Parliament. The first head of income, by Charter of Queen Anne (October, 1707), and Act 48 Geo. III.; the other heads by the authority of the Duke of Portland.

Joseph Maynard, *Commander, R.N.*

AYR.

No. 408.

No. 408.
Evidence taken on the 23rd Oct., 1846.

Examining Commissioner—Capt. Washington, R. N., F. R. S.

Present:—Provost Miller, John Paul, Wm. Pollock, Bailie Moore of Newton, Hugh Park, T. M'Clelland, A. Wise, P. Maxwell, J. M'Neillie, T. Reid, R. Alexander, — Cuthbertson, A. B. Telfer, — Highet, and Dr. Mitchell, together with other individuals, including ship-masters.

The Commissioner, after inspecting the harbour, the quays, the piers, &c., in company with the Provost, some of the Harbour Trustees and the officers of the port, proceeded to the Town's Buildings, where the proceedings were formally opened by reading the Royal Commission, on the authority of which the investigation was made. He stated that this was an enquiry into the past and present state of the harbour of Ayr, and as to its capabilities for future improvements; that the meeting was public, and that he would be glad to hear the opinions and suggestions of merchants, ship-owners, sailors, pilots, and in short of all interested in the welfare of the port.

Mr. Davin Wilson, Clerk to the Harbour Trust, examined.—Having produced the Act of Parliament under which the harbour was managed, he stated that the last Act was obtained in July, 1835. It set aside a previous Act, the 57th of George III., granted in 1817. Previous to that Act he believed the affairs of the harbour were governed by the Magistrates and Town Council, who had a right in the harbour. They managed the affairs under no particular powers; their charter, granted betwixt 1165 and 1265, by William the Lion, having given a right over a certain defined extent of land embracing the harbour. The Town-Clerk, now, had nothing to do with the harbour. The Clerk also read the list of parties from whom the Trustees are elected, and the number from each body; explaining, in answer to the Commissioner, what the Sailors' Society was. In all there were 24 Trustees; of these seven were ship-owners, but no practical sailors. The Act did not require that any number of the Trustees should be actual sailors.

Mr. Paul said it was difficult, from their frequent absence, to get any shipmasters to act under the Trust; and, in answer to the Commissioner, said that there were few retired shipmasters in Ayr owners of vessels.

Mr. Wilson.—The Act required the Trustees to meet quarterly. There was a standing Committee, which met every two or three weeks. The Trust was authorized to borrow 10,000*l.* 2000*l.* had been borrowed at 5 per cent. As to the limit of jurisdiction, the Trustees could prevent nuisances from being cast into the river below the Milldam-dyke, on the east; they had no power to improve above the bridge. (The clause of the Act as to nuisances was then read.)

Mr. Paul.—Some time ago the Trustees had to take stringent measures to prevent the sand from a quarry up the river being thrown into the stream.

Mr. Wilson.—They had jurisdiction over 350 yards to the north and south of the harbour. The proposed improvements were within this extent. The Act authorized the Trust to prevent rubbish being cast into the river. No complaints had been made to the Board of rubbish thrown into the river, except in the cases mentioned. A good watch was kept at the shipping-places.

The Commissioner remarked that they would require to look sharply after parties shipping coals; for, from what he had seen that morning he was afraid a good deal of coal fell into the harbour.

Mr. Wilson.—The Act required the bye-laws of the port to be exhibited on a board at the harbour—which was done. The board had power to examine and license pilots. There was no pilot board; but the Trustees examined pilots before licensing them. (The minute book of the Trust was now examined.) Witness was not treasurer. Minutes of Committee meetings were kept separate. The resident engineer, pilot, and treasurer made quarterly reports. At a general meeting eight was a quorum—no difficulty in getting a quorum. At every meeting the minutes of the preceding meeting were read and signed. In the Clerk's department there was no other book but a letter-book. The plans of harbour lay with the Collector.

Mr. M'Clelland asked if the Trustees had any power to prevent rubbish being thrown into the river above the Mill-dyke. If not, power should be obtained in any future bill.

The Clerk said that statements had been made that rubbish was thrown into the river at various parts of its course, but he was afraid at present they had no power to prevent it.

The Commissioner thought the question important, and asked if any one present could testify to the fact.

No one could do so; and, at the request of Mr. Paul, the Commissioner agreed to recommend that such power should be granted on any new bill afterwards obtained.

The Commissioner, at the conclusion of Mr. Wilson's evidence, expressed himself to the effect, that so far as a cursory examination enabled him to judge, the books were well kept, and duly signed.

Mr. James Gray, collector and treasurer, was then examined. He had held office for seven years. He did know what was the revenue 20 years ago. In 1826 it was 1014*l.*; in 1831, 1100*l.*; in 1836, 890*l.* [the coal trade, it was explained, was then very depressed]; in 1841, 1507*l.*; and in 1845, 1520*l.* From 2*d.* to 4*d.* a ton was paid by all vessels, according to size, as harbour dues. On goods, either export or import, 4*d.* per ton was paid, either by weight or measurement, and according to a schedule. Neither coal nor freestone paid duty. In coal was the most extensive trade. Both coal and freestone were specially exempted by the last Act. Witness was not collector then, and could not tell the reason of the exemption. He knew no reason why these exports should be exempted here. The trade was not heavily burdened: the coal-masters were the richest people in the place. There was pretty good accommodation afforded to colliers. On the north side there were railways to the hurries at the quays. Both railways and hurries were made at the expense of the coalmasters; but the latter had been repaired by the Trust. Four-fifths, or at least three-fourths, of all the coals shipped were shipped at the north side. Only knew one port—Irvine—where no dues on goods were levied. At Glasgow 2*d.* was imposed; at Troon, 4*d.* per nett ton of coal. If there were more accommodation afforded for ships the duties would produce a larger sum. More water would be a great boon. The surplus dues are put in the bank weekly. Witness gave security to the amount of

APPENDIX C.

AYR.

No. 408.
Evidence taken on the 23rd Oct., 1846.

300*l*. A quarterly statement was submitted to the statutory meetings, after being examined by the Finance Committee. The accounts were audited by an accountant who was not one of the harbour trustees. The auditor was paid; but as no money was paid out without a mandate, he had not the power to disallow items. The auditor saw that there was a voucher for every thing.

COMMISSIONER.—Suppose the Trust voted 500*l*. to build a church or a bridge, would he pay out the money?

Mr. JAMES GRAY.—So far as he could see, the Trustees had absolute power over the funds.

Mr. PAUL.—A statement of the income and expenditure has to lie at the Custom-house for the inspection of all; and if such an item occurred, any person could take the matter before the Sheriff or the Court of Session; and such an absurd item would be disallowed, or, in other words, the Trustees would be obliged to refund it.

Provost MILLER.—The Act stated the purposes for which the dues were levied, and if any such appropriation took place, he thought at common law the Sheriff would disallow it.

Mr. JAMES GRAY.—The accounts are printed in the newspaper reports of the Quarterly Meetings, but not officially.

The COMMISSIONER thought they should be officially printed.

Mr. JAMES GRAY.—To grant 500*l*. for the repair of a bridge would not be in the power of the Trust. Never knew of such an appropriation. The present debt is 2000*l*. There was a debt of 976*l*. when the late Act was got. In 1843 the debt was 2580*l*.—it had thus been reduced 580*l*. Five per cent. was paid upon it to the Ayrshire bank.

The COMMISSIONER thought that money might be got at a lower rate of interest.

(The Treasurer's books were then submitted and examined.)

Mr. JAMES GRAY received pilotage dues and paid the pilots their salaries. The light-houses were built and lighted by the Trustees. They were never visited by the Commissioners of Northern Lights. The salaries of the Clerk, Superintendent, and Collector, put together, were only 125*l*. The Collector was not paid commission on the money received. The dredging cost about 300*l*. a-year, which was the greatest annual expense. The great bulk of the funds was laid out in improvements. [The Collector's various books were then examined.] All the books were signed. The Act did not compel the Trustees to submit the accounts to an auditor; but for the satisfaction of the public and themselves they submit them. A return was kept of all arrivals. Coal vessels were the most numerous. [The pilotage books were next gone over.] There were a master-pilot, his mate, and three boatmen. All vessels above 50 tons must take a pilot. The master-pilot had 60*l*. a-year; his mate 52*l*.; and the three boatmen, 14*s*. a week. The pilotage receipts cleared these, and left about 100*l*. a year over. No complaints had been made to witness of the incompetency of the pilots. [The ships' register book was now gone over.] The chairman at the meetings always signed the minutes.

The COMMISSIONER submitted to the Trustees that the revenue books, if examined by an accountant, should be signed and docketed by him. The initials only of the accountant were in the book, and if they came before the House of Commons they would not stand as evidence.

Provost MILLEN.—The quarterly accounts, before being submitted to the general meetings, were always examined and docketed by the Finance Committee.

The COMMISSIONER.—So far as he could perceive, with the exception of the signatures, the books were in order and well kept.

Mr. THOMAS M'CLELLAND said the Commissioner had asked why coal was charged no dues. He had a paper in his hand, a copy of which was laid before the Trust when, in 1842, they took preliminary steps to obtain a new Bill. That paper, which, with permission, he would read, set forth the reasons alleged against levying an impost on coal. The paper was then read. It contained twelve or thirteen reasons: the first was, that the Bill, obtained about seven years before, exempting coal, had fourteen years to run; that under that new Act the harbour prospered, larger and more valuable vessels frequented it, the debt was reduced, and the income increased; third, because the revenue was more than sufficient for all the demands upon it, and no costly works were needed for the coal and freestone traffic; fourth, if more funds were required, the Trustees had not exhausted their means; fifth, the vessels coming to the port for coal already paid a heavy tonnage duty, &c. &c. Mr. M'Clelland stated that these were *not* his sentiments, but he thought it right to make the Commissioner aware of the paper.

The COMMISSIONER thought Mr. M'Clelland had judged rightly; and requested to be furnished with a copy. (See Appendix, p. 551.)

Mr. PAUL said the paper just read had been brought forward by parties opposed to an alteration of the rates proposed in 1842. At that time, from the greater accommodation likely to be required by traffic from the proposed railways, a majority of the Trustees thought it necessary that a new Bill should be procured for the improvement of the harbour. They also thought it quite reasonable that some revenue should be got from coal and freestone. But they were opposed by a portion of the Trust, by whom the paper read by Mr. M'Clelland had been drawn up. The names of Mr. Gordon, a large coal proprietor, and others interested, were amongst the signatures to the document read; of the other names, Mr. P. Cowan was not now a Trustee; Mr. John Sloan was dead; Mr. Carnie was at present indisposed; Mr. Morton attended the last meeting of the Trust, and seemed to approve; Mr. Kinross was not now a Trustee; but there were some of the gentlemen present who would speak for themselves.

Mr. R. ALEXANDER was in favour of the application.

Bailie MOORE of Newton stated he thought that some improvements must be made.

Mr. HUGH PARK said he thought the harbour stood in need of improvement. As to the duty on coal, there were some of the gentlemen present who were engaged on the last bill; and if they were asked, probably they would tell why coal was specially exempted by it.

Provost MILLER.—When the proposal to go to Parliament in 1842 for a new Bill was first started, there was a distinct understanding that 18 or 19 out of 24 Trustees were in favour of it. However, latterly, the proposers found the majority dwindling away, until at a meeting there were 12 on one side and 12 on the other, the vote to proceed having only been carried by his (the Provost's) casting vote as chairman. With such a narrow majority, the proposers then thought it better not to take steps in the matter. The notices, however, were given.

In answer to the Commissioner it was stated that the expense of obtaining the last Bill was within 500*l*. There was no opposition to it. Had there been, it would have cost 1000*l*. at least.

Mr. PETER ALEXANDER, Superintendent of Harbour Works, examined.—He had been 10 years

Appendix C.

Ayr.

No. 408.
Evidence taken on the 23rd Oct., 1846.

connected with the harbour, and seven as resident superintendent. He had been for 14 years previously engaged at Portpatrick harbour, under Sir John Rennie and Mr. Logan, and three or four years on the Clyde. [The Commissioner put to witness a number of questions as to the works on which he had been engaged at Portpatrick.] The harbour of Ayr, when he came, was in much the same state as at present; only the breakwater was not then constructed. The south quay was understood to have been originally built about 1772. The north pier was extended out about 1800. The south pier was rebuilt about 20 years ago; the engineer was the late Mr. Wilson of Troon. Mr. Galloway was contractor. Thought the piers had answered the purpose for which they were built. The breakwater was laid down in 1836, to enable vessels to lie more easily in the harbour in certain winds—the design was by Mr. John Gibb, C. E., Aberdeen. Its length was about 400 feet. It was up to high water of common tides, and built of rubble stones. The swell came over it. It should be raised. The intention was to face it on the inside. The original design was not completed; and it was not in a state to stand. Severe gales occasionally threw the stones down on the inside. It had to be mended several times. Had no doubt that it must be completed to enable it to stand. It would then be serviceable to vessels warping out, and to the large timber vessels, many of which could not get up further without discharging. A new quay was built by contract, on the north side, under his superintendence, last year. It was about 150 feet long, and cost upwards of 600*l*. The old quay walls were at present in a very dilapidated state. The freshes, which now come down rapidly, had undermined the walls repeatedly. The walls are built of stones too small. There is a want of quay room. The swell did not come up violently farther than the low burries. The breakwater had quieted the harbour very much.

The Commissioner here examined the large plans of the harbour made 10 or 12 years ago. He saw a perch marked at the extremity of the old pier, beyond the present south pier head, and inquired what had become of it, as he had not seen it when making an examination. He was told that the perch was removed, as all the stones had been taken away that could be taken without a diving-bell. None were left in the track of vessels. He was also told that in 1830 Mr. Stevenson, C. E., of Edinburgh, made a survey, and proposed several improvements, which however were rejected—Mr. Gibb's proposal of a breakwater being preferred: there were then only 2 feet 6 inches of water over the bar.

Mr. Alexander.—There were now 5 feet at low water over the bar; that depth was obtained by dredging. A steam-dredge was got in 1837, at the recommendation of the Trustees. It cost 1400*l*. It had only eight-horse power. Although useful, it was not sufficient. The bar was of sand; it re-formed at every fresh, whether in summer or winter. Sometimes *in a winter* as much as 3 feet, or 10,000 tons of sand, had been deposited on the bar. The banks of the Ayr were mostly sand and shingle, which the freshes undermined and carried away. The fresh that undermined the south wall left about a foot on the bar. South-west breezes assisted in cleaning the bar, sweeping the sand into the north bay. Although he had not bored, thought that clay was beneath the sand on the bar. The bottom of the harbour was clay, though the dredge had never got so far down. In sand the dredge can work at only 9½ feet deep, but in gravel at 10½ feet—the sand, as it were, flying from the buckets, the gravel dropping into them. Dredging was of more effect in clearing the bar than south-west winds. The bar was about 100 yards across. A track was dredged right through the bar, when necessary, the lights being always kept in one. Not more than 20 or 30 feet in width of a channel was cut. They could only work from half ebb to half flow in smooth water. A more powerful machine could cut a very deep channel in a month or so. South-west gales would not fill up the channel, by washing stuff from its banks, more than a few inches. Had been down about 9 feet at low water, but never got beyond shingle.

Mr. Paul, in answer to the Commissioner, said—Mr. Leslie was called in by the Trustees to state what the harbour wanted, and to furnish plans for going to Parliament. He (Mr. L.) saw the previous plans; and that Mr. M'Derment was now engaged, under Mr. Leslie's direction, to take soundings, and to ascertain the substratum by boring and otherwise.

The Commissioner.—There is no datum line on Mr. Stevenson's plan. The Trustees should write to Mr. S. in Edinburgh and ascertain his line, which would make his plan of great comparative value.

Mr. Alexander.—Knew of no way of keeping the bar clear but by dredging. A machine of twenty-horse power was needed. They had four punts, these were sufficient to serve the dredge when engaged on the bar. The entrance of the harbour was about 320 feet wide between the south pier head and the head of the breakwater. The proposed improvements were—the construction of pools such as steamers and sail vessels might lie afloat in secure from freshes, and the improvement of the bottom of the harbour.

Mr. M'Clelland asked if Mr. Leslie contemplated a wooden gangway from the north pier head to the breakwater, to make use of the latter as a landing quay. Witness had seen vessels run through the opening in a gale of wind. The wharfage was frequently so taken up that vessels had to lie three abreast. The tide flowed to the Ayr mill-dam dyke, or about half a mile. The dyke was 8 or 9 feet deep above the level of the bed of the river. If that dyke were removed, the tide might flow to the Over Mill, a mile farther up. If the dykes were away it might improve the river.

The Commissioner.—The farther they could get the tide to flow in the better, it would secure a greater volume of water, and a long-continued ebb, which would act as a most effective scour to the harbour. [In answer, it was stated that the mills mentioned belonged to the corporation, and yielded an annual rent of about 200*l*. each.] The same thing was witnessed at Chester; these dam-dykes were the ruin of every tidal harbour.

Mr. Alexander, in answer to the Commissioner, said,—Dredging cost the Trustees about 5*d*. per ton.

The Commissioner.—If the dredging cost about 300*l*. per year, probably the Trustees might find it worth while to buy up these mill-dykes. At all events, he trusted they would ask Mr. Leslie to level so far up the river, and learn his opinion.

Mr. Alexander.—Could not dredge near the walls, as they were in many places founded on a level with the bed of the harbour. The depth in the harbour was irregular. Opposite the tide light-house there was a set given to the river, and it was always deep there. There were three cranes, one to lift six tons, the others three tons each.

Mr. Gemmell (of Sloan and Gemmell).—The patent slip was proved for vessels of 400 tons, though larger ones could be taken up. It was found a great accommodation. There was one building-yard. The largest vessels built there were about 600 tons burden.

Mr. Alexander resumed.—Opposite the new quay there were large boulders in the river, some of

APPENDIX C.

AYR.

No. 408.
Evidence taken on the 23rd Oct., 1846.

2½ tons weight. A diving-bell was much wanted to lift them. The dredging could not injure the new bridge, as there were 200 or 300 yards of solid rock betwixt it and the harbour. Thought it would be cheaper to lift the rubbish at the bar than to do so at the dam-dyke. Thought it would be of advantage to build a weir somewhere about the bridge. The rubbish raised by dredging is thrown into the north bay. There was no probability of its coming back. Large stones had been placed behind the north pier to preserve it.

The Commissioner could not recommend a weir near the bridge; on the contrary, the Commissioners, he said, were endeavouring to do away with all the dam-dykes and weirs in the kingdom. As already remarked by him, they had been the ruin of all harbours.

Mr. John Young, master-pilot. Had been twenty-five years a seaman; eleven years a pilot at Ayr. Within seven years, since dredging had begun, the harbour had improved in depth about 2½ feet. There was now 5 feet on the bar, formerly only about 2½ or 3 feet. It was possible, with more dredging, to get a greater depth. Knew no better way than dredging. If there were a depth of 2 feet more, it would let vessels in easier. Freshes ran at the rate of 5 and 6 knots an hour. Recollected of one or two vessels having been caught by freshes on the bow and thrown near the breakwater. If the anchors had been ready and thrown over they would have prevented that. There was good holding ground in the bay, about one mile and a half off. Had known vessels get ashore on the south beach, and get off without injury. Had never, or very seldom, known vessels break away. The breakwater had done away with the violence of north-west swells. A south-west swell would pass through the opening into the north bay. To face up the breakwater would be a great benefit. A gangway, from it to the north pier head, might be of some use. Had seen vessels driven through there, and on to the bank. In a strong fresh, or with off-shore winds, generally ran vessels in so as to get hold of the walls. More quayage was needed on both sides. A wet dock was much wanted, as many sharp coasters and timber vessels traded with the port. Ice did not do any injury, as it generally came down in small pieces. Freshes caused some little trouble. In winter especially, more quayage was much needed. Sometimes fifty and sixty vessels were in at once, and lying four a-breast.

Mr. William Highet, water-bailie, or harbour master, agreed with the preceding witness as to the improvements needed by the harbour. A diving-bell was very much wanted. Vessels would damage their bottoms on the stones if not carefully looked after by the pilots. Next to a diving-bell a more powerful dredge-boat was needed. Docks at both sides of the harbour were much needed, both for steamers and sailing vessels. A new source of traffic, by the steamer *Scotia*, had opened up betwixt Ayr, and Campbelton, and Stranraer, in connexion with the railway. The number of timber ships was increasing. Vessels of 350 tons now got in. 15 feet was the greatest draft brought in; but some vessels were so large as sometimes to require to discharge part of their cargoes in the bay. Thought coal ought to pay dues—had not the least doubt of coal and freestone being good items on which to lay an impost. There was plenty of freestone in the neighbourhood; there were three quarries, the Ann-pit, the Content, and the Bell-rock. The stone was exported in considerable quantities to Belfast, Dublin, Liverpool, &c.

Mr. Young.—A current sets into the north bay. In calm weather the flood-tide sets easterly, the ebb-tide was west and north-west. The flow of the tide always set into the bay, and not directly up Clyde.

The Commissioner.—Mr. M'Derment should be requested to take the set of the current along with the soundings.

Mr. Young.—Thought none of the dredged stuff came back from the north bay. No perch or buoy was on the Nicholas—the rock visible at low water. A buoy was on the outer Nicholas, quite sufficient to mark it. The north buoy was merely a fair-way buoy. A south-west gale, after dredging, assisted to clear the bar; a north-west gale to fill it up. There were four pilots besides witness—their pay was satisfactory. The Trustees examined pilots before licencing them. Witness berthed vessels. There was a very serviceable beaching place for the swell at the small pier.

The Commissioner to the Trustees.—Take care to preserve that beaching place.

Mr. Young.—The trade of the port was greatly on the increase. Upwards of 1000 coasters and 18 foreigners arrived in a year. No pilot had been pensioned for old services. Agreed with all preceding witnesses had said as to necessary improvements. The harbour was pretty easy to take in a gale. The night previous (Thursday night) a loaded schooner came in in a heavy gale at a quarter-ebb tide. There was a heavy sea on the bar. The schooner drew 7 feet 9 inches. She was bound to Glasgow—came in from stress of weather. Thought there was plenty of buoys. The harbour light was shown all night. The tide light from half-flood to half-ebb. The course into this harbour was E.S.E. One of the pilots kept the lights. He had a tide-mark, which he examined with a lantern.

The Commissioner.—Not very safe or sure on a snowy winter night. It would be better if a float were provided inside of the lighthouse, which could easily be done.

Mr. Young.—In stormy weather, to make sure, allowed the half-tide flood to be somewhat passed before showing the light. A vessel went ashore last winter by keeping too far to the south, and mistaking the south pier-head for the breakwater. She got easily off again. A flag showed the half-tides by day.

Mr. Telfer asked if the breakwater made a greater deposit of sand in a fresh? Witness thought so, particularly in north-west winds. He had seen before the breakwater was built one flood take away the deposit left by a preceding one. Before the breakwater was built, the bar, then a bank of sand, never had 5 feet at low water. Vessels of 12 or 13 feet only could come in.

Mr. Telfer understood that about ten years ago there was 7 feet on the bar.

Provost Miller said that in 1826 a steamer traded to and from the port. She drew 8 feet, and never could enter or depart before half-flood.

Bailie Moore recollected, about forty years ago, there was a bar of sand over which he had walked dry-footed. He had known Mr. Taylor send down a number of his colliers with shovels to cut a channel through it.

Mr. Telfer thought if the piers had been built with a direction more to the north, so as to harmonize with the river and current, it would have been better.

Mr. Paul thought it would have made the harbour more difficult to be taken with a scant-wind.

The Commissioner said, he put questions to all the witnesses with the view of eliciting opinions on the very points of whether it might not have been more advantageous so to have placed the breakwater as to have caused the ebb-stream to harmonize with the prevailing current, but it appeared

APPENDIX C.

AYR.

No. 408.
Evidence taken on
the 23rd Oct., 1846.

that they all approved of the present position of the breakwater. Of course it was too late now for Mr. Telfer's suggestion; but, from what had been stated, he thought the preponderance of good was in favour of the breakwater. Mr. Leslie, however, ought to inquire closely into the matter.

Mr. R. **ALEXANDER** had heard seafaring people say, that the entrance of the harbour was much too narrow.

Mr. **PAUL** thought it was as broad as the entrance to Troon Harbour.

Captain **SKELLY**, of the schooner Lord Byron, of Drogheda, had traded to the port for about fourteen years. There was a great improvement in it within that time. His first vessel drew $9\frac{1}{2}$, his present one $11\frac{1}{2}$ feet. Vessels frequently strained on the stones after heavy freshes. They would not break away if properly moored. The pilots, when vessels arrived, saw them properly moored before they left them. Often found much inconvenience from want of sufficient berthage. He would prefer a wet dock. It would not be material which side was chosen. Thought all vessels would willingly pay dues for the sake of being always afloat. The breakwater should be smoothed on the inside. One of his owner's vessels had once been damaged on it. The pilots had only open boats, and could not go out in heavy weather. He generally approved of what the preceding witness had said. The entrance was as wide as that of Troon, which was being narrowed.

Captain **STEVENSON**, of the schooner Eglinton, examined. He stated, that he had been acquainted with the harbour for two years. The breakwater should be quayed, and raised considerably above high-water mark. The draft of his vessel, which is sharp, is 10 feet. Engaged in general trading. In bad weather prefers running for the harbour to beating about. Great danger in taking the harbour at night, from the lowness of the breakwater. Agrees in all that has been advanced by previous witnesses as to the necessity of immediate improvement. A wet-dock would be of most advantage to the general trade.

The **COMMISSIONER** inquired of Mr. Alexander if he could keep a tidal basin, 10 feet deep, open at the mouth, and at the same time carry on the dredging of the harbour, &c., with the present machine?

Mr. **ALEXANDER** was afraid it could not all be done.

Mr. **CUTHBERTSON** said, if the dock were constructed at the pool near the small lighthouse, where the water was already 10 feet deep, and the dock made the same depth, it could surely be kept open.

Mr. **ALEXANDER** said it could.

Captain **STEVENSON** found the currents generally running towards the north-east. The breakwater had no doubt been a great improvement, but it would be adviseable to carry it still farther out. Did not think Troon Harbour had a wider entrance, and he understood they were about to contract it.

Mr. **M'CLELLAND** inquired if there had ever been any fault found with the lights.

Captain **SKELLY** replied, that he had frequently been perplexed by them. One at the extremity of Wellington-square, the light rising from the lime-kilns, and a number on the north side had frequently deceived him.

Mr. **HIGHET** said that the Act of Parliament provided for this.

The **COMMISSIONER** recommended, that in framing the new Act, powers be taken to blind all lights towards the sea. He thought that at present they were not far enough advanced with their arrangements to enter minutely into the details of the proposed improvements.

Mr. **PAUL** said it was not intended to go minutely into these proposals at present, but the trustees only wished to let it be distinctly understood that they were really desirous of getting the harbour improved.

Captain **SKELLY**.—The stones in the bed of the river are no worse at present than formerly. The freshes are most felt on the south side.

Mr. **HIGHET** said, the best way to get quit of the stones would be to get a diving-bell. Indeed he thought that the procuring of such a machine would be of the greatest advantage to the harbour.

Provost **MILLER** said, that as he had long been connected with the Harbour Trust, he might state, for the information of the Commissioner, some of the steps that had been taken regarding it for a number of years past. During the currency of the Harbour Act passed in 1817, when the trustees consisted chiefly of the magistrates, complaints were made that the management was too close and restricted, and a desire was felt that the trustees should embrace a wider sphere. The magistrates willingly agreed to the general feeling of the public, and before the expiry of the then existing Act, they went to Parliament, when the now current bill was got, by which the trust was composed of parties named by the various public bodies in town. Consisting, as it now did, however, of 24 members, he was of opinion that it was too numerous, and that somewhere about the half of that number would make it more effective. The many interests which have now to be recognised in the appointment of Trustees, caused it to be sometimes difficult to get parties properly qualified, and to take an interest in it. In the movement which was made to get a new bill in 1842, one of the chief objects was to obtain a rate on coal and freestone, but as had before been alluded to, the effort at that time failed. Previous to 1835, there had been no rates levied on goods of any kind, the whole duties being put on the shipping, which gave rise to much complaint on the part of ship-owners. The new bill of 1835, however, gave powers by which duties had been levied on all goods, except coal and freestone, and it was now the general feeling that they should no longer be exempted. A rate even of 2*d*. per ton would raise about 800*l*. or 900*l*. of revenue annually to the harbour; and when so many improvements were required, it was necessary that all the means in their power should be made available.

The **COMMISSIONER** said, that if his services could be of any benefit to the trustees in forwarding their Bill they were at their command. He would be most happy to assist them in any way he could with propriety.

Provost **MILLER** thanked the Commissioner for his kind offer, of which the Trustees would no doubt gladly avail themselves, and said that, being a Director in the Glasgow and Ayr Railway, he was enabled further to state, as a reason for the Trustees immediately applying for a new Bill, in order to procure a rate on existing exemptions, that that railway company were making arrangements for the construction of three railways, all of which would influence Ayr Harbour. One of these was from Ayr to Girvan, another from Muirkirk to Ayr, and a third, which he had no doubt would be gone on with, was the Ayrshire and Galloway. These, when completed, would greatly increase the trade of the harbour, and the exports, particularly in minerals, would, he anticipated, be increased three or four fold. Hence the anxiety of the Trustees to get the matter settled before those interests came into collision with them.]

APPENDIX C.

AYR.

No. 408.
Evidence taken on the 23rd Oct., 1846.

The COMMISSIONER said, that no reasons that he had heard had been adduced for exempting coal and freestone from paying dues. The reasons contained in the protest which had been made on a former occasion were, he thought, by no means conclusive.

Dr. MITCHELL, in reference to the statement of the pilot regarding the general currents on the coast, remarked that all streamlets and rivers in this district tended towards the north, and consequently during the freshes, all the sand or shingle brought down was carried in that direction.

No. 409.

Return by the Harbour Trustees, of Maps, Plans, &c.

Ayr, April 3, 1845.

No. 409.
Return by the Trustees of the Harbour.

AN Act of Parliament was obtained in the 12th year of his late Majesty George the Third, entituled "An Act for deepening, cleansing, scouring, preserving, and maintaining the Harbour of Ayr, for enlarging and improving the quays and piers; for erecting docks, breasts, jetties, and piers; and for regulating ships, lighters, and other vessels trading into, and going out of the said harbour, and for other purposes therein mentioned."

The term of this act was continued by a subsequent act, obtained in the 34th year of the reign of his said Majesty George the Third, entituled "An Act to continue the term and enlarge the powers of an act made in the 12th year of the reign of his present Majesty entituled 'An Act for deepening, cleansing, scouring, preserving, and maintaining the Harbour of Ayr, for enlarging and improving the quays and piers, for erecting docks, breasts, jetties, and piers; and for regulating ships, lighters, and other vessels trading into, and going out of the said harbour; and for other purposes therein mentioned.'"

Another act was again obtained in the 57th year of the reign of his said Majesty George the Third entituled "An Act for improving and maintaining the Harbour of Ayr, and for regulating vessels resorting thereto."

And shortly before the expiration of this last Act of Parliament, the present Act was obtained in the 5th and 6th years of the reign of his late Majesty King William the Fourth, entituled "An Act for the farther improvement of the Harbour of Ayr."

Under this act the present trustees act and regulate the affairs of the Harbour of Ayr.

This return is accompanied by copies of

1st. A plan of the Harbour of Ayr, and projected improvements thereon made by Robert Stevenson, Civil Engineer, Edinburgh, dated 17 June, 1830.

2nd. Report by Mr. Stevenson dated 16 June, 1830, relative to said plan and improvements.

None of the works detailed by Mr. Stevenson in his plan and report have been executed, with the exception of partially removing some of the rocks and scouring some of the sandbanks laid down on said plan in the interior of the harbour.

On the copy of this plan now sent, the harbour and places adjacent are laid down as they at *present stand*, in consequence of several alterations having taken place upon these, since said plan was prepared, and the breakwater partly executed in terms of plan No. 3 has also been laid down on it, but no alteration whatever has been made on the works as proposed by Mr. Stevenson in his plan and report.

3rd. A plan by John Gibb, Civil Engineer, Aberdeen, dated 28th July, 1836, of a proposed breakwater at the entrance to the harbour.

4th. Specification relative to said plan and proposed works.

This breakwater has now been partly executed.

5th. Report relative to the harbour lights of Ayr, dated 20th September, 1841, by Robert Stevenson and Sons, Engineers of the Northern Lights.

The alterations recommended in this report have now been carried out. A tower of masonry has been built, in place of the wooden structure therein mentioned, which contains the principal lights at the harbour, and the seaward or lower light is likewise now in a cast metal erection since constructed, and placed as recommended in the report. New lights have also been provided and put up in both light-houses as therein recommended.

Gas has also been since introduced into both light-houses.

No written complaints have ever been made to the trustees relative to the defects of the harbour.

The depth of water on the bar and in the harbour has lately been much increased by means of a steam dredging machine, and the harbour is still progressively improving in many respects, and it is capable of still farther improvement.

DAVID WILSON, *Clerk to the Harbour Trust.*

No. 410.

Report of JOHN SMEATON, Esq., C.E., F.R.S., *on Ayr Harbour.*

Austhorpe, January 22, 1772.

No. 410.
Smeaton, on improving the Harbour.

FROM a view taken the 2nd of September, 1771, it appears to me that the harbour of Ayr, which is near the mouth of the river Ayr, which falls into the wide and open part of the Firth of Clyde upon a flat coast with a drift of sand, is by nature badly circumstanced for keeping open, having constantly a bar before its mouth, as almost all others in like circumstances are more or less subject to; and were it not for the river Ayr, which, being a river of middling size, and subject to great speats in rainy seasons, which drive the sands out to sea that the surge with westerly and north-westerly winds brings in and heaps upon the entry of the harbour, it would be very speedily choked up and destroyed. Seeing therefore that the speats of the river Ayr are in a manner the only means by which the harbour is kept open, it follows that to improve the same in depth of water, which is the present object, it is necessary to attend to those circumstances by which the force of the land-waters can act with the utmost advantage in driving off the sands, and to the forming and improving of such artificial barriers as shall have the most direct tendency to prevent the effect of the winds in bringing them in.

Appendix C.

Ayr.

No. 410.
Smeaton, on improving the Harbour.

Something for this purpose has been done many years since in the erection of the north and south dikes or walls to confine the channel of the river in passing the flat sands, but, not having been effectually executed, the depth of water in the harbour is not so good as it might have been; however, though I have reason to suppose. when what I have to propose is executed, that there will be a gaining of full 3 feet additional depth of water at a medium, yet, as the action of the winds to bring in sands and the floods to drive them out are the two powers that are opposed to one another, but at different times and in different degrees, it follows that, from the nature and operation of such inconstant forces, there will always be times when the depth of water will be alternately greater and less.

The principal fault of the present dikes is their lowness, which, being in a great measure covered at half-flood, the speats are left unconfined from half-flood to half-ebb, whereby a material part of the power of the speats to scour is lost. Another material thing is, that, the south dike being so low, the seas find a passage over a great part of it, even at one-quarter of flood; and the sands appearing to drive coastwise from the south-west to the north-east by the westerly winds, the south dike does not prevent the sands from being washed over it into the channel of the harbour, and which must then remain till the speats come to drive them out again. Lastly, as the north-west and northerly winds act very powerfully on the mouth of the harbour, and the seas having a long fetch from the north down the Firth of Clyde, they have power enough to prevent the larger gravel that comes down the river from getting out to sea, and thereby form the north bank, extending from the north pier to the north-west, so as to bar up the harbour entirely to the north, the bank being dry at low-water, and forcing the land-waters to take their course to the westward. When a number of large speats happen, this bank almost directly opposing the land current, the bank is driven out more to the northward, so as to admit the vessels to steer in from the north-west; but by a series of northerly winds, without freshes, this bank is brought closer in, so as to oblige the vessels to steer in from the west-by-north, as it was in when I saw it, and sometimes from the west; and as this is the direction nearly of the two present heads, vessels there going in with a scant wind are apt to be driven upon the north pier.

The most obvious remedy for those evils, in part, is to build up both the south and north dikes to high-water mark; for by this alone a considerable part of the obstructions will be removed, the sands will be prevented from driving into the harbour from the south-west, and, the speats and land-floods being confined, they will act more powerfully upon the bottom, and therefore, being preserved in one column till they pass the heads, they will act more forcibly upon the north bank to drive it off, and by that means not only keep the channel more to the north, but also make deeper water over the bar. It is not a matter of calculation to determine what additional depth will be hereby gained, but I should expect it will be not less than 18 inches over the bar.

The shape and position of the north bank show how the powers of nature are balanced; and though it may be very desirable to force a passage right through the bank directly out to sea, yet this seems too great a thing to be attempted. I apprehend it better to conform to nature than to attempt to force her, as I take it for granted it will be more desirable to have a good deep passage out at north-west than an indifferent and obstructed one at north or north-north-west.

It is with a view doubtless of keeping the channel to the north that the south dike was carried out so much farther than the north, but yet it has not had this effect; for though the seas have power enough to keep up the north bank at such a height as to prevent vessels going over it, yet, being covered at young flood, it is so low that speats find their way over it in so great a breadth as not to be able effectually to remove it; by this means a great part of the force of the land-waters is spent in a fruitless effort to do what they can never sufficiently accomplish to answer any good purpose. I therefore propose to turn their whole effect to such a quarter as by co-operating with nature they may act with full advantage, and thereby maintain the greatest depth of water possible in such a situation.

This will be done by lengthening out the north dike or pier towards the west, as shown in the plan, by which means, the whole force of the back-water being spent in a north-west direction, and the north bank prevented from being driven in by the seas into the harbour, I expect there will be more water over the bar than at present by at least 3 feet, and the direction in and out permanent to the best situation it is at present capable of.

The only objection I see to this prolongation of the north head is, that the north-west seas will fall right into the mouth, and carry a swell into the harbour; but as this harbour, by the south point of the Mull of Cantire and the north of Ireland, is in fact land-locked from every quarter, there never can be any violent surges such as coasts open to the ocean are subject to; and the quay is so far upwards from the mouth that what comes in will be in a manner spent before it comes to the place where the ships lie. However I apprehend this will be the least of those evils the harbour is subject to, and in all artificial harbours we have only the choice of the least evil.

The present irregularity of the north and south dikes makes it very difficult to form an estimate of the expense of completing them; but taking it for granted that stone can be procured at the same price as that employed for the new coal-quay, the best I can make will be as follows:—

Estimate.

	£.	*s.*	*d.*
The north pier, being supposed 16½ chains long, = 363 yards; and supposing half of this to want being raised at a medium 4 feet high and 5 feet thick, will contain 403 cube yards, at 7*s.*	141	1	0
To rubble for footing the present dyke, viz. 2 yards per yard running for the harbour side, and 1 yard per yard running for the outside, viz. for the whole length, 1089 yards, at 6*s.*	326	14	0
To making up the south dike, being supposed 19 chains or 428 yards long, being supposed 12 feet thick at base, 5 feet at top, and 10 feet high, will contain 4042 yards, at 7*s.*	1,414	7	0
To lengthening the north dike by an additional pier of 5 chains long or 110 yards, to be at a medium 15 feet base, 5 feet top, and 15 feet high, will contain 1833 yards, at 7*s.*	641	11	0
Net estimate	2,523	13	0
Allow for contingencies, at 10 per cent.	252	7	4
Total	£2,776	0	4

John Smeaton.

No. 411.

Rennie, on extending the Piers and on making a Wet Dock

No. 411.

Report by JOHN RENNIE, Esq., C.E., F.R.S., *on extending the Piers of Ayr Harbour, and making a Wet Dock on the North Side.*

London, August 1, 1805.

AYR is situated on the west coast of Scotland, and on the eastern shore of the Irish or St. George's Channel, in the bottom of a bay of the same name. It lies in about 55° 26′ north latitude, and 4° 39′ west longitude.

The bay is bounded by Ardrossan Point on the north, and the Heads of Ayr on the south. But the Heads of Ayr may, in fact, be said to be in the bay, for the land keeps extending to the westward as far as Finard Head, the eastern side of the entrance to Loch Ryan, the western side being formed by Kirkcolm Point. The distance between the Point of Ardrossan and Kirkcolm Point is upwards of 40 miles, so that in fact this bay may be said to give little or no shelter to the harbour; and were it not for the island of Arran, which lies about N.W. by W. of it, and at the distance of about 18 or 20 miles, there would be such an extent of sea for the storms to act upon in the direction of the mouth of the harbour as would render its entrance much worse than it now is. But Arran gives shelter to a certain extent, and prevents the storms from that quarter proving so injurious. But its exposure to the west, south-westerly, and northerly winds is such as to occasion great annoyance to it, for from these quarters the seas have a long fetch from St. George's Channel and the Firth of Clyde, and against them, therefore, such artificial barriers should be formed as to render the entrance as safe, and the water as deep, as the nature of circumstances will admit.

The harbour of Ayr is formed and kept open by the river of that name, which falls into the open part of the Firth of Clyde upon a flat shelving sandy coast, along which the sand is driven by the storms from the south-west to the north-east; the river is subject to great floods, and brings down considerable quantities of large gravel, which, when carried into the sea, is met by the tide, and a stagnation takes place, during which the water drops its mud, and forms a bank or bar across the harbour's mouth, as is the case with all other harbours formed at the entrance of rivers. This bar varies in distance and height according to the seasons. In dry seasons the river sends but little water to sea, the tide and winds force the sand inwards, and the bar approaches nearer to the shore, and is of greater height; but in rainy seasons, when heavy floods are brought down from the interior of the country, the bar is driven farther to seaward, and, by the force of the water acting on it, reduces the height, and of course the harbour at the end of a wet season is always in its best state. These being the principles upon which the goodness of such a harbour depends, and by which its depth of water is maintained, it becomes necessary to attend particularly to the preservation of the force of the land-waters, so as to make them act in a connected body on the bar, and to guard the entrance as much as possible from the prevailing winds which annoy it the most.

In the year 1771 a plan was laid down for the improvement of Ayr Harbour by my very able and ingenious friend Mr. Watt of Birmingham, formerly at Glasgow. His plan was to build two straight jetties or piers; the one from the head of the south dike, and extending to the distance of about 150 yards beyond it, the other from a point about 100 yards within the head of the north dike, of 345 yards in length, so that both heads went equally far into the sea, and the jetties or piers were nearly parallel to each other, and in a direction of about W. to N. By this direction the entrance to the harbour would have been sheltered from the winds south of west and northerly of north-west, and from thence to the north, namely those winds which bring the heaviest swells into it. But it seems to me, had this plan been followed, the parallelism of the piers would have been a great objection, for, although by such a construction the flood-waters of the Ayr would have been made to act in a connected body on the bar, yet the waves, meeting with no interruption in passing up the harbour, would have occasioned such a swell at the quay as would have rendered it very unsafe for shipping to lie at anchor, fully as much so as at present, where they have been known to beat their keels out in stormy weather.

In September 1771 my late worthy and ingenious friend Mr. Smeaton took a view of this harbour, and in January 1772 made a design for, and wrote a report on the improvement of it. Mr. Smeaton's project was to allow the head of the south dike to remain in its present situation, but proposed to extend the north pier about 155 yards, which was about 30 yards farther to seaward than the southern pier; and, instead of making this in a straight line, as by Mr. Watt's construction, he proposed to give it the form of the sand called the North Bank, thus opening it more to the south, and by this curved form the seas would have been prevented more from running up the harbour than they would had Mr. Watt's plan been adopted, and of course vessels lying at the quay would have experienced less inconvenience from the swell of the seas. In this construction, Mr. Smeaton has obviously followed that kind of form which the balancing powers of nature have given to the sandbanks on each side of the entrance to the harbour. I apprehend the principle on which the old construction was adopted, namely, of making the south pier longer than the north, was to force a passage across the bar; but this seems to me too great a thing to be attempted; besides, as the greatest seas come from the northward, it was surely against these winds the harbour ought to have been guarded instead of opening the mouth to them. Both Mr. Watt and Mr. Smeaton saw this, and wisely designed their works accordingly, none of which, however, seem to have been carried into execution. Now, as the south pier extended beyond the north so much, the mouth lay quite open to the north-westerly and northerly winds, and had no shelter except what is got from the north bank, and this was so little that the storms threw the sand and gravel in such quantities, as I have been informed, that, when there was little water in the river, the channel has been so contracted as scarcely to leave a passage wide enough for a vessel to pass, independent of the water being about 2½ feet shallower; besides, the storms from the north-west and north often force the sand and gravel over the top of the north dike, and thereby occasion great obstructions in the channel of the river, which none but very heavy floods can carry away; this last is owing not only to the frequent failures in the dikes themselves, but also to their being too low. The head of the north pier is only about 9¼ feet above the low-water of an ordinary spring-tide, and the dike or wall itself is about a foot lower; so that, as ordinary spring-tides rise from 10½ to 11 feet, they always cover both the dike and head; and in great springs, which take place with strong south-westerly winds, they rise from 13 to 14 feet, so that both the dike and head are covered long before high-water: ordinary neap tides rise from 7½ to 8 feet, and therefore frequently cover the dike.

APPENDIX C.

AYR.

No. 411.
Rennie, on extending the Piers, and on making a Wet Dock.

It is therefore little wonder that, in storms from northerly points, sand and gravel are blown over the top of the dike.

The harbour at the time I saw it was in a very good state. It was the first day after the change of the moon, on the 24th of January, 1803, and two days before the height of the springs: the tide rose 11 feet 8 inches on the index. There was opposite to the quay from 12 to 14 feet of water, and 12 feet on the shallowest part of the bar. But in the summer season, in short water, there has been known, and at no very distant period, not more than 9½ feet at the top of an ordinary spring-tide.

The most obvious mode that appears to me for the improvement of this harbour, and bringing it into the best state its capability admits, is to raise both the north and south walls or dikes to the full height of an ordinary spring-tide, and indeed two or three feet higher would be better; this would not only prevent the sand and gravel from being beaten over the top of the wall into the harbour, so as to obstruct the passage of the floods or speats to sea, but would also keep them in a body, and thereby enable them to act more powerfully in scouring out the channel.

The piers I would propose also to be extended, and the best mode, at least that which appears to me the surest to produce the wished-for effect, namely, of increasing the depth of water over the bar, is to follow, as nearly as convenience will admit, the form that the north bank has taken. But, instead of extending it only about 155 yards, as Mr. Smeaton proposed, I would advise it to be extended about 215 yards, which will carry it quite to the Ness, or extremity of the north bank. But it should not be quite so much curved as the bank itself.

The south pier I also propose to extend about 100 yards, by which it will fall 35 yards short of the northern pier; it will thus be partly covered from the north-westerly and westerly winds, and, although as an entrance it will not be quite so easy of access as if opened more to the north, yet there will be a greater depth of water, which will more than compensate for the disadvantage of its direction, not to mention the shelter that will thereby be given to the interior harbour. But, in proportion as an increase of depth is obtained at the entrance, the swell of the seas will be propagated to a greater distance upwards, and therefore, should, after all, any inconvenience be experienced by the vessels lying at the quay, it can be prevented by a variation in the form of the north dike, near about the place where the head now stands, which will not be attended with a considerable expense. It is not an easy matter to calculate, *à priori*, the increased depth of water that will be obtained on the bar by the plan proposed. But I should expect it would be little, if anything, short of 2 feet; so that in ordinary spring-tides there would be good 14 feet of water on the bar, and in neaps from 10 to 11 feet.

In respect to the interior part of the harbour, the depth is at present full as great at the quay, and at the east end of the north dike, as on the bar, I mean opposite to what is called the Ropery in Mr. Gregg's plan of 1771. But it will be short of this when the bar is deepened 2 feet; therefore some ballasting will be required to give it this additional depth, which I have little doubt the confined current of the river will be able to preserve.

At the east end of the north dike an entrance may be made to a wet-dock, to be formed in what is called the Nawton Lock; or one may be made on the town side, if sufficient and convenient ground can be had for that purpose, but which, from having made no such survey, nor having a correct plan of the town, I am not able to arrange; I have, however, drawn a wet-dock nearly parallel to the river, about 80 yards wide by 300 yards long, having its westerly end at the west side of the Newton Lock, so that it will cover about five acres, and the entrance-lock to be placed at the south-west angle, and to join the harbour at the east end of the north dike, near where the Ropery before mentioned is placed. But, although I have thus drawn it, I cannot pretend to say the position × is the best. But, should a wet dock be determined on, and should the magistrates of Ayr require me, I can examine this on my way to Ireland, about the end of August next, and make a design accordingly.

A wet dock, formed something in the way I have represented, would be of great advantage to the trade in general, but particularly to vessels in the coal-trade; for these, proper conveniences could be made for loading the vessels; and as, when a vessel has got her cargo on board, she could be shifted and another put into her place, without waiting for the tide, it would enable them to make great despatch in taking on board their cargoes. Vessels employed in the foreign trade would also reap great advantages from a wet dock; because, as they are generally of a more sharp and tender construction than those in the coasting trade, they cannot without injury lie aground with heavy cargoes on board.

The interior part of Ayrshire abounds in iron-stone, in coal, and various other valuable productions. The soil in general is fertile; situations for manufactories are abundant, with excellent streams of water and falls; these render it desirable that opportunities should be afforded of carrying them on to advantage—for which purpose a canal or an iron railway may some time or other be extended into the heart of the country, and probably at no very distant period. Should this take place, it would occasion a very great increase of trade at Ayr, should the harbour be properly improved, so as to accommodate the shipping; but if not, it would be an inducement for them to seek some other situation, where they could obtain the conveniences they require. This would be a serious injury to the town of Ayr, and therefore no opportunity should be lost of giving to the harbour all the improvement of which it is capable. The improving of the entrance is no doubt the most material object; after which a wet dock claims the next attention, as it would so much facilitate the loading and discharging of vessels, and their preservation from the injury of storms, more than they could by any possible improvement obtain in the river. A canal might communicate with the wet dock more conveniently than with a dry harbour; railways could also terminate there with more advantage, and dry docks for the repair of ships might be made on the wet dock, discharging their water into the tideway, so that by this means every interior accommodation wanted could be obtained that the trade could possibly require.

JOHN RENNIE.

No. 412.

Second Report by JOHN RENNIE, Esq., F.R.S., *on making a Wet Dock at Ayr.*

No. 412.
Rennie, on making a wet Dock.

London, January, 1806.

IN my report of the 1st of August last I gave my opinion pretty fully respecting what I considered the best manner of improving the harbour of Ayr, and to which I have now but little to add, except what arises from the survey on which my design was made having been found incorrect, and also from a change of position in the proposed wet dock, arising from the situation of the houses in the Newton of Ayr, preventing it from being executed in that way, of which buildings I had no plan then to represent their situation.

No. 412.
Rennie, on making a Wet Dock.

The extension of the north and south piers I now propose to be done on the same general principles I formerly stated, but, instead of the north pier requiring to be extended 215 yards, I find it will only require to be extended 175 yards, and, instead of the south pier requiring to be extended 100 yards, I find it will only require to be extended 60 yards; these diminished lengths will, no doubt, save a considerable sum in the expense of the new works, but, as some parts both of the present north and south piers are in very bad repair, I do not think it will be advisable to diminish the amount of the estimates I stated in my former report, as the saving upon the new works will, I apprehend, be required to repair the old in a proper manner; I will therefore allow those estimates to stand as before.

As to the proposed wet dock, instead of its being parallel to the river, as in my former plan, I now propose it to be nearly at right angles to it, as a considerable part of the ground on which the other plan of the dock would have been laid is now occupied by buildings, which would be expensive to remove. I have placed it in such a situation on the unoccupied ground as will leave room not only for a wide and commodious quay round it, but for such warehouses or other buildings as the trade may require.

The entrance into the harbour I have laid down opposite the rope-walk, where the water is shallow, and of course a considerable expense will be incurred in deepening it: the entrance would have been much better had it been lower down,—I mean near the coal-yard, where there is 12 feet depth of water in ordinary spring-tides; but as, in this case, the dock will occupy a part of the ship-yard and rope-walk, I doubt the expense would be greatly increased by the purchase of those properties, unless an exchange could be made by giving ground for ship-building and rope-making higher up the harbour, equal to what is taken away, or indeed a complete removal would be better, which may possibly be effected at no very heavy expense. If the Newton Loch were to be filled up, which could be done by the earth from the proposed wet-dock, in this case the dock would be as represented by the dotted lines.

I propose the dock to be 14 feet deep under the level of the high-water of an ordinary spring-tide, and as the earth which comes out of it will raise the surface, the quay-walls will require to be 18 feet high.

The lock I propose to be 140 feet clear length in the chamber, and 30 feet wide,—perhaps it might be made somewhat less, say 122 feet by 27: of this the ship-masters trading to Ayr can judge better than I; my reason for making it so much is to admit ships in the east-country trade, which are frequently larger in proportion to their drafts of water than others which trade to countries where the harbours are deeper.

According to this design a wet dock of about five acres area, with a lock 30 feet wide, will cost about 16,036*l*., according to the prices I have put to the work; but as the particulars are stated in the annexed estimate, if they can be done more cheaply, so much of course will be saved.

JOHN RENNIE.

The Provost and Magistrates of Ayr.

No. 413.

Report of ROBERT STEVENSON, Esq., C.E., *on the Improvement of Ayr Harbour.*

Edinburgh, June 16, 1630.

No. 413.
Stevenson, on the Improvement of the Harbour.

AGREEABLY to an arrangement made with Mr. Sloan, Dean of Guild, the reporter visited Ayr in the month of February last, when he examined the harbour and attended a meeting of the Trustees; and having since obtained the accompanying survey, with the necessary soundings or depths of water, both in the interior of the harbour and seaward of its entrance, he reports as follows:—

It appears from the records of the Harbour Trust, that the late eminent Mr. James Watt gave a design for the improvement of the harbour of Ayr, so long since as the year 1771; that the celebrated Mr. Smeaton reported on the same subject in 1772; and the late Mr. Rennie, in 1806. It is also important to know, that these three eminent engineers were pretty nearly of the same opinion, regarding the improvement of this harbour by an extension of its piers. The Trustees have accordingly very properly followed their advice, in so far as regards the extension of the southern pier, which they placed under the able direction of Mr. John Wilson, of Troon, civil engineer; and it further satisfactorily appears, that by these operations, the water upon the bar of the harbour has been deepened by about 2 feet.

The reporter also states, that after an attentive consideration of the shape and figure of the land forming the bay of Ayr, and of the soundings or depth of water at the entrance of the harbour and current of the river, it is not a little gratifying for him to find, that he is led to adopt the principles so well matured and laid down by those eminent men, in now recommending the further extension of the piers, agreeably to the accompanying designs of this date.

As the harbour of Ayr lies quite open and exposed to northerly winds, and as the greatest fetch or run of the sea is from that quarter, the reporter proposes to extend the northern pier westward, somewhat in the direction of the low-water bank, called the North Knowe. This form seems to be that which nature prescribes, while it is calculated to leave a more ample space for the spend or spread of the sea within the pier heads. By this design or plan it will also be observed, that both of the pier heads, as marked with red colour, form a kant or turn toward each other; and from either head, as the intelligent mariner will see, vessels may make sail with the greatest facility in going to sea; while the moment they enter within the piers, they will be sheltered from the storm.

The reporter is fully satisfied from experience and observation, that by the extension of the north pier, as now suggested, the bar will be thrown into deeper water. In illustration of this, he particularly calls the attention of the Trustees to the form of the bar on the plan, on which the depths of water are indicated in feet, by the figures in red colour for low-water of spring tides, and those in black colour for the depths at high-water. From these, it appears that immediately seaward of the bar the ground suddenly dips, from about 14 to 18 feet; and the reporter has no hesitation in stating it as his opinion, that by the proposed extension of the piers, together with the excavation of the rocks in the interior

APPENDIX C.

Ayr.

No. 413.
Stevenson, on the Improvement of the Harbour.

of the barbour, that the bar may be thrown seaward so as permanently to afford a depth of about 4 fathoms upon it; while the depth will be proportionably increased up the barbour.

In connection with this view, it is intended that the rock marked with red colour, between the Ratton-hole and the New-bridge, should be excavated or lowered to an average depth of about one foot. This operation will tend to regulate the stream and equalise the depth of water, in a manner to which no other operation can give effect. The waters of the river Ayr, which are pent up in this distorted part of the channel, from the position of these rocks, may be said to *play at billiards*, being deflected at an angle similar to that with which it impinges against the opposite side; and hence the present irregular state and condition of the bottom of the harbour.

Some objection, it is believed, has been made to the removal of these rocks, by the process of blasting with gunpowder, from an apprehension that hazard might attend the shaking of the connecting strata of the adjoining coal pits. The reporter has inquired into this subject, and he has no doubt in being able to satisfy the very intelligent proprietor of these works upon the subject. But such an objection only implies the necessity of resorting to a more expensive mode of excavation, by the pick only instead of the use also of gunpowder. At all events, they should be reduced in height, so as to allow the current to flow freely down the harbour.

It has been proposed to establish wet-docks at Ayr, and various places have been suggested as the site of such an establishment. Although the reporter is of opinion, that ships can never lie commodiously in the current of a rapid river, yet with great submission he begs to notice, that such an establishment would seem out of place, while the entrance of the harbour remains in so unprotected and exposed a state. A wet-dock, it may also be observed, without a sea-lock, becomes merely a tide-basin, which would be comparatively of little use. It must necessarily change its waters every six hours, and much deposition would constantly be going forward. In a wet dock on the contrary, the waters are only partially changed at high-water during the range between neap and spring tides, while they are comparatively in a pure state.

It has been proposed by some to form an insulated breakwater at the entrance of this harbour, instead of building continuous piers. On this subject the reporter has perused some very sensible correspondence, sent him by the Trustees as relative papers. He must, however, be allowed to express his opinion as wholly in favour of extending the northern pier, in the manner laid down in red colour on the accompanying plan. By this plan, there will be no danger of changing the bed or course of the river, nor of endangering the present navigable track at the entrance of the harbour; an evil which might be incident to the erection of an insulated breakwater. The Trustees, by simply extending the piers, may do so in accordance with their funds, and to such an extent as they may from time to time find convenient. Every step taken will be upon a sure and beaten path; but in the case of a breakwater, the effects must be attended with uncertainty; and when once the operation is embarked in, the outermost expense must be incurred. Upon the whole, the reporter could not recommend the adoption of this measure, while he fears the Trustees would incur a responsibility at variance with the professional advice which they have from time to time received.

The principle upon which the deepening of this harbour greatly depends, arises from the tidal waters being kept in a confined state so much nearer the bar, and passing four times in the twenty-four hours over the bottom of the barbour, together with the advantage of the occasional land-floods, altogether tending to deepen and improve its entrance. It is also to be kept in view, that the piers, as laid down upon the plan, may be said to project about 500 yards seaward of *high-water mark*, thereby giving an immense space for the waves to spend upon the north and south sands on either side of the harbour.

There are minor points deserving the attention of the Trustees in connection with these improvements; such as the dilapidated state of some parts of the piers, particularly on the northern side of the harbour, which will be better pointed out on the spot than by any descriptive account of such works. The reporter has also, on several occasions, brought the very inferior state of the harbour-lights at Ayr, under the notice of the Trustees. Situated as these lights are, in connection with a bar-harbour, and at the bottom of a deeply-indented bay, these lights ought to be more distinctly marked than they are.

Though the reporter has estimated the extension of the piers, as now proposed to be built, in a breakwater form, as will be seen from the sections on the plan, yet he recommends, that before his stating the amount, or allowing this to go abroad, it would be better for the Trustees to advertise for the execution of at least a part of the work, agreeably to a specification, and thereby to obtain offers at a certain rate per lineal yard of finished pier, of which 100 yards for execution may be guaranteed to the contractor. In this manner a progressive estimate would be obtained, upon which the Trust could proceed agreeably to its funds.

ROBERT STEVENSON.

To the Trustees for Maintaining and
improving the Harbour of Ayr.

No. 414.

Report by MESSRS. ROBERT STEVENSON AND SONS, C.E., *on the Harbour Lights.*

No. 414.
Stevenson and Sons, on the state of the Harbour Lights.

Edinburgh, September 20, 1841.

AGREEABLY to arrangement, Mr. Alan Stevenson visited Ayr on the 15th instant, and in company with Mr. Paul, and the harbour-master and superintendent, examined the harbour-lights of that port, and from the information obtained by his inspection, we have now to report as to their improvement.

The timber erections, from which the lights are at present exhibited, are of a temporary description, and ought to be replaced by towers of a more permanent nature; but we cannot recommend the Trustees to proceed to any important improvement in this respect in the present state of the harbour, the contemplated extension of which ought to be fully determined upon before any measures be adopted for a complete renovation of the lighthouses, as their sites may admit of being considerably modified, so as to accord with any enlargement of the harbour accommodation which may be ultimately resolved on. The seaward or lower light is, however, so little raised above the level of the sea as to be *masked* by the pier head from vessels approaching in certain directions; and we think that the substitution of

APPENDIX C.

AYR.

No. 414.
Stevenson and Sons, on the state of the Harbour Lights.

an iron pillar, about 15 or 20 feet in height, in place of the present wooden house, which is in a ruinous state, may be safely adopted without farther delay, as the site of this pillar could be afterwards easily changed if required. The two higher lights may in the mean time be continued in the landward wooden house; but no time should be lost in taking measures for maturing the plans of the extended harbour-accommodation, so as to permit the construction of a tower of masonry to be proceeded with before the present erection, which is considerably decayed, shall become completely useless by age.

In order to render the lights efficient in the meantime, no great expenditure is required; and we would suggest that the improvements should be of such a kind as may be suited to the contemplated improvements of the harbour itself. It does not appear necessary to illuminate more than a quadrant of the horizon; and this may be both most efficiently and economically done, by employing for each of the three lights a single argand burner in combination with a small refracting belt in front and a reflecting ribbon at the back of the flame. By this arrangement, every part of the horizon, within the required limits, will receive an equal portion of light, while the expenditure of oil or gas will be reduced to one-half of that which would be required for maintaining the present number of lamps of an improved construction.

This improvement of the lights may, we think, be easily completed, for a sum not exceeding 70*l.*; and as no alteration of the character of the lights, which would render a public advertisement necessary, is contemplated in the change, the work might be proceeded in without delay.

ROBERT STEVENSON AND SONS.

To the Trustees of Ayr Harbour.

No. 415.

Protest against a Rate on Coal.

No. 415.
Protest against a rate on Coal.

Ayr, November 3, 1842.

AT a Special General Meeting of the Trustees for the Harbour of Ayr, held this day, a resolution having been been proposed, and carried by the casting vote of the Preses, Provost MILLER, that "Application should be made to Parliament, in the ensuing session, for a discretionary power to exact a rate on coal and freestone, not exceeding twopence per ton," the following reasons of dissent and protest were lodged by the Trustees subscribing:—

1. Because the present Act was obtained after mature consideration, only seven years ago, by agreement among all parties interested, and with the deliberate and full knowledge and approval of the public of Ayr. It was declared to remain in force for twenty-one years, and therefore to attempt now to alter an essential part of it is a great breach of good faith.

2. Because the Harbour has prospered remarkably under the present Act, and both its condition and finances are now in a flourishing state. It is so much improved and deepened that much larger and more valuable vessels frequent it than formerly did. The income of it, on an average of the last three years, is at least 1600*l.*; while, for the three last years under the former Act, it was only 917*l.* Its debt to the bank is reduced to about 1100*l.*; and the surplus of income over ordinary expenditure, including all the heavy charges for dredging, is at least 700*l.*

3. Because the revenue of it is already more than sufficient for its maintenance, and the execution of any rational improvements. No costly works are required for, or would benefit, the Coal or Freestone Trade; and if any such be necessary for other trades, then these ought to be taxed, and not coal or freestone, which would receive no benefit from them.

4. Because, if more funds be required for the harbour, the present powers of the Trustees have not yet been exhausted.

5. Because the coal-trade already contributes four-fifths, or, at least, three-fourths, of the whole revenue of the harbour; for though this be, in the first instance, paid by the vessels laden with coals, yet, as it is necessarily deducted from their price, it forms a direct burden on, and payment by, them. That the charges thus levied on coals, which are worth about 6*s.* per 20 cwt., is 4*d.* per ton, and the charge on vessels with goods, and their cargoes, which are worth at least fifty times that amount, being only 8*d.* per ton, it follows that coals already pay charges greatly out of all proportion to other goods, in reference to their value, which is the main principle of taxation adopted at other ports.

6. Because, for the reason last mentioned, and also that the harbour has been made, and hitherto maintained, almost solely at the expense of the Coal Trade, and is the staple trade of the port, it would be more equitable and just to reduce the charges on vessels with coal than to impose any additional rates on them or their cargoes.

7. Because those engaged in the trade of coal or freestone have made their pecuniary engagements, and embarked their capital, on the faith of the present Act; and it would therefore be most unjust, during the currency of it, to place any further tax or restriction on them.

8. Because any additional impost on these articles would be more likely to injure than to increase the trade and revenue of the harbour, and is totally at variance with the experience and policy of the present day, which are to remove restrictions from trade, not to impose them.

Further, and lastly—As the Trustees, under the present Act, are bound to apply the funds of the harbour to the direct improvement of it, "and not otherwise," we protest that they shall not be applied towards the expenses of an attempt to obtain a new Act, which is altogether unnecessary and inexpedient at the present time; and that the Trustees applying for the same shall be held individually responsible and liable for the payment thereof; and such of us as are creditors of the harbour further protest against any such application of the funds until the debts respectively due to us be liquidated and paid.

JOHN T. GORDON.	R. ALEXANDER, Jun.
P. COWAN.	ADAM CARNIE.
JAMES PATON.	JAS. MORTON.
JOHN SLOAN.	JOHN KINROSS.
JOHN MOORE.	HUGH PARK.

No. 416.

Report by JAMES LESLIE, Esq., C.E., *on the choice of a Site for proposed Dock, and Estimate.*

No. 416.
Leslie, on the site for proposed Dock.

GENTLEMEN, *Edinburgh, December* 18, 1846.

THE estimates of the two proposed plans for a tidal dock, for deepening the river, and for finishing the breakwater, have now been prepared, and I beg to submit to you the amounts. They are as follows:—

Tidal dock on south side of the river, including 1266*l.* for land	£34,250
Tidal dock on north side of the river, including 100*l.* for about ¼ acre of land . .	30,300
Deepening the river so as to give 3½ feet more water over the bar	2,070
Finishing the breakwater and raising it to the level of 2 feet above high water of spring tides	2,250

These all include 10 per cent. for contingencies after being calculated at what I consider fair prices.

Both plans of the docks are exactly the same size, viz. 450 feet by 300 feet, making an area of fully three acres, and the depth is calculated in both at 18 feet in average spring tides, and consequently the amount of accommodation that would be afforded by them would be the same in both.

They are both equally capable of extension by having a wet dock formed at the inner end as shown by red lines on a few copies of the engraved Parliamentary plan—the facilities afforded for vessels entering or departing are very much alike—the nature of the ground is nearly similar, clay being found on both sides, but at a depth rather below the proposed bottom of the dock; and upon the whole I consider it to be a matter of indifference which of the two plans be adopted, excepting in so far as regards the expense and the convenience of the situation. The south side I should consider to be the most convenient for the great bulk of the inhabitants of Ayr, and it is equally so as regards a connexion with the railways in progress and projected, but the expense is considerably greater owing to the greater amount of excavation and to the value of the land required for the site of the dock and quays.

If the south plan be adopted, the river wall and dock entrance will occupy the mouth of the present beach or slip, which is useful both for allowing the waves to spend their force on instead of running up the harbour, and for hauling up timber; and consequently I am of opinion that in that case an opening will require to be formed on the north side.

If the finances of the harbour would permit, it would be of advantage to have a dock on either side of the river, as there are coal railways on both sides, and probably the construction of the one may lead to the other; but I must leave it to your Board to apportion the respective weights due to the question of expense and to the question of local convenience, and to decide which plan it is better to begin with.

A suggestion having been made when I first visited Ayr as to forming a harbour having its entrance not from the river but directly from the sea, I beg to say that in my opinion no harbour having an entrance other than that by the river can be formed at Ayr without an expenditure far beyond what the amount of the harbour revenues could justify, and that, even if it were attainable, the measure would be of but questionable expediency; for I am by no means satisfied that the river Ayr does not do more good by its action as a scour than it does harm by depositing mud, sand, or gravel in the fairway; and a separate entrance, unless it were removed to a very considerable distance from the river-mouth, would be liable to have the detritus of the river carried into it by the flood tide without having a fresh-water scour to carry it out again.

I consider the breakwater to be very judiciously placed, as it protects the harbour-mouth from northerly winds, and allows the sea in southerly winds to pass through between it and the north pier-head, instead of being deflected and sent up the harbour, as it would probably be by a continuous extension of the north pier.

I think however that it would be a considerable convenience to have the breakwater connected with the north pier, so as to give access to it at all states of the tide to hand a rope or for any other purpose, which could be done by means of an open wooden gangway, which would allow of the sea passing through below it, and, from its being quite removed out of the line of the fairway, would not be liable to be run foul of by vessels.

I have &c.,
JAMES LESLIE.

The Trustees of the Harbour of Ayr.

No. 417.

Statement by J. T. GORDON, Esq., *of Blackhouse, relative to the Harbour of Ayr.*

No. 417.
Gordon's statement respecting the Harbour.

Newton Lodge, December 31, 1846.

I HAVE been elected a trustee for the harbour by the shipowners of the port of Ayr ever since the passing of the present Act of Parliament in the year 1835. I carry on an extensive trade at it in the shipment of the coals raised from my collieries in the neighbourhood. That trade amounts to four-fifths, or at least three-fourths, of the entire trade of the harbour. I was not present at the examination made by the Tidal Commissioner regarding the harbour in September last, as I was then, and had been for some time previous, in another part of Scotland; and neither I nor any of my agents or managers received any notice from the authorities in Ayr of that examination, though it appears the Commissioner gave them such timely intimation of it as would have enabled them to cite me or my agents if they had thought proper. Important information was on that occasion withheld from Captain Washington, which I deem it proper now to convey to you.

The harbour is managed by 24 trustees, 13 of whom are members of the Town Council, either ex-officio or elected out of the Council; these being generally banded together, the other parties, consisting of shipowners and others, have almost ceased to interfere in the management, as they find themselves overruled by the Town Council of Ayr. These members of the Town Council are, with one or two exceptions, utterly incapable of properly exercising their duties as trustees of the harbour: I attach no blame to them on that account, because their education, business, interests, and status have necessarily unfitted them for the acquisition of any knowledge about the harbour. It would be easy for me to

APPENDIX C.

AYR.

No. 417.
Gordon's statement respecting the Harbour.

prove what I have said by entering into further particulars regarding these members of the Town Council, but this might be personally offensive, and I therefore refrain from doing so. I beg to conclude this part of my statement by giving it as my decided opinion that the harbour of Ayr is thus placed under a most incompetent and incapable management.

Considerable funds, derived from the harbour of Ayr, are not applied to it, but to the municipal purposes of the town of Ayr, by which, and other means, the inhabitants are saved from the usual burden of cleaning, paving, and lighting their streets, &c. The Town Council of Ayr levy, from every vessel entering the harbour, anchorage-money; they likewise levy on every ton of goods exported or imported, on either side of the harbour, considerable dues. These together, I believe, amount to several hundred pounds per annum; not one farthing of this is given to the harbour funds, or expended on the harbour, except the payment of one-half of the expense of lighting and maintaining the road on one side only of the harbour, which amounts to about 20*l.* or 25*l.* per annum; with this trifling exception the whole of these funds are applied to the municipal purposes of the town. The road or quay on the south side of the harbour, being that next to the town of Ayr, is well kept and lighted by the harbour Trustees and the Town Council, but that on the north side, where the whole of my trade (forming, as I have already stated, three-fourths of the entire trade of the harbour) is carried on, has not one single light, and the quay-road is almost, if not entirely, neglected. No watch is kept, and robberies on board of ships are frequent.

The finances of the harbour are at present in a good state; the annual income of it is about 1600*l.*, and its ordinary expenditure is about 700*l.* or 800*l.*; there is a nominal debt of 2000*l.* due by it, which was incurred by the purchase of a steam dredge-boat, with punts, &c., for the working of it. These the Trustees still possess, and therefore this debt may be said to be neutralized by the property belonging to them. Considerable improvements have been made in the harbour of Ayr, and large sums have been expended on it, within the last few years; new lighthouses have been built; a breakwater has been formed; and the harbour has been considerably deepened; and I am of opinion that, if the funds of it were economically and properly managed, all the repairs and improvements necessary for the existing trade might, in course of no long time, be accomplished with them. The harbour has been made and maintained, I may say, by the coal-trade carried on by me and my predecessors. I have to compete with the superior harbours of Troon and Ardrossan, which have been made for the collieries in their neighbourhood at immense expense by the Duke of Portland and the Earls of Eglinton. I have likewise to compete with the harbour of Irvine, which is a public harbour as that of Ayr is. Looking to these circumstances and the superior character of these harbours, the trade at the harbour of Ayr is already overtaxed. On a vessel of 100 tons the cumulo charges at these places are as follows, viz.—Ayr, 2*l.* 12*s.* 1*d.*; Troon, 3*l* 15*s.*; Ardrossan, 2*l.* 17*s.* 11*d.*; Irvine, 1*l.* 13*s.* 4*d.* Besides, I have erected, and have to maintain, at my sole expense, hurries and the necessary apparatus for loading the vessels with my coals, while at Troon and Ardrossan these have been erected and are maintained by the harbours. Notwithstanding, that portion of the Trustees of the harbour of Ayr who are Town Councillors are applying to Parliament for such additional taxes on the trade as would make the charges higher than those at Troon, nearly a third higher than at Ardrossan, and three times higher than at Irvine. The increase of charges is notoriously wanted, not to make improvements for the existing trade, but to make docks and other improvements for an entirely new trade expected to be derived by means of contemplated railways in this neighbourhood. With this idea the Trustees last year applied to the Railway companies to advance them money to make these improvements, but having failed in this they are now attempting to raise these funds almost entirely out of my private pocket, and this in utter violation of the present Act of Parliament, which is little more than half run, and which, by unanimous agreement of the whole community, fixed the duties as they are at present exacted from me, and on the faith of which I have entered into heavy engagements.

While the Town Council are attempting this injustice they insist on retaining and appropriating to their own purposes the anchorage and other funds which are levied by them as before explained. This determination appeared from the proceedings of a meeting of the Harbour Trustees held on the 9th day of this month, when the following resolutions were proposed by Mr. George Taylor, the Trustee elected by the Sailors' Society, viz.:—

> "The Trustees are most anxious to improve the harbour, and that adequate funds should be raised for that purpose in a fair and legitimate way.
>
> "That, before putting an additional tax on the existing trade of the harbour, it is fair, just, and equitable that the anchorage and other dues levied on vessels or their cargoes, at present appropriated by the Town Council of Ayr to purposes totally foreign to the harbour, should be applied to the improvement and maintenance of it.
>
> "That on the above income being surrendered and applied for the benefit of the harbour, coal and freestone should pay one penny per ton in addition to the present heavy charges which they have to defray.
>
> "That the clerk be directed to make immediate application to the Town Council of Ayr for their consent to the introduction, into the new Act of Parliament, of a clause giving the anchorage and other dues to the harbour.
>
> "That the Trustees earnestly hope that the Town Council will agree to this proposal, otherwise they will not deem it expedient to proceed with the said Bill.
>
> "That the following Committee be appointed to frame and adjust the details of said Bill in the event of said application being agreed to:—The Provost, Mr. Paul, Mr. Telfer, Mr. Paton, Mr. M'Cosb, and Mr. Gordon."

These resolutions were not carried, as the whole of the members of the Town Council of Ayr, and who as before stated, form a majority of the whole trustees, voted against them.

JOHN T. GORDON.

The Tidal Harbours Commissioners.

No. 418.

Return of Income and Expenditure for the Years 1842–3–4.

INCOME.									
Heads of Income.	1842			1843			1844		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Tonnage dues on vessels	998	12	6½	823	2	5	976	2	4
Ditto on goods . .	199	10	1¼	205	18	3	220	19	11½
Pilotage dues received	327	7	7½	284	11	5	349	14	11
Plank, shute, crane, and fender dues; stones and gravel sold	54	14	11	57	11	3½	56	13	3½
Rents	12	5	0	15	13	0	15	15	0
Town's proportion of expense of upholding south quay road .	5	15	7½	10	8	4½	5	2	0½
Ditto of cost of road metal	2	6	7	..			..		
Income-tax on interest of debts	..			4	16	11	3	6	9
Total . . £	1,600	12	5	1,402	1	8	1,627	14	3½

EXPENDITURE.									
Heads of Expenditure.	1842			1843			1844		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Salaries	69	7	0	68	11	0	68	19	0
Paid pilots, and boatmen, &c. .	227	3	9	218	16	0	224	7	0
Dredging, including repairs to north quay wall, &c. . . .	345	8	1½	314	1	6	371	8	5½
Three payments of 5 per cent. on 1,800*l.*, advanced by subscribers for dredging machine . .	90	0	0	90	0	0	90	0	0
Repairs and works	220	13	8	266	7	1	422	11	4½
Lighthouse, new work, and new light apparatus, carriage, &c.; oil, candle, keeper's salary, and allowance for rent	394	11	4	155	11	11½	47	7	2
Lighting quays with gas. . .	17	9	7½	17	9	7½	17	9	7½
Rent of ballast bank	5	0	0	8	0	0	8	0	0
Stationery, law expenses, printing, postage, and coal for harbour office	9	8	2½	23	12	5½	5	19	2
Subscription for survey of projected mineral railway. . .	10	0	0	..			..		
Interest on advances for dredging machine	81	0	0	76	10	0	72	0	0
Interest on bank advances . .	55	19	10	50	10	11	37	6	6
Income-tax	..			8	18	9	9	7	0
Dredge-boat, repairs, &c. . .	..			..			133	5	3½
Deposit at bank	68	9	9	109	13	6	119	15	8
Total . . . . £	1,594	11	3½	1,408	2	9½	1,627	16	3

The dues are levied under the authority of the Ayr Harbour Act, 21st July, 1835, the 41st section of which empowers the harbour company to levy a charge of 5*d.* per ton per register on British vessels, and 1*s.* per ton on foreign vessels; but the following is the scale charged:—

			Per ton.
Registered tonnage,	vessels	under 20 tons . .	2½*d.*
Ditto	ditto	20 and under 40	3
Ditto	ditto	40 and under 80	3½
Ditto	ditto	80 and upwards	4

No Signature.

Debt due on the 1st of January, 1846, 2171*l.*

Girvan.

No. 419.
Return of authority to levy dues.

GIRVAN.

No. 419.

Return of Authority to levy Dues, &c.

Sir,

Girvan, March 11, 1846.

I have been favoured with yours of the 7th inst. The harbour of Girvan, with its anchorage and shore money, belongs, by charter under the Great Seal, to the lands of Ballochtone, the property of the Duchesse de Coigny, and is maintained from time to time, as is seen necessary, at her Grace's expense, without reference to the actual income.

There is no debt ranked against the harbour.

I am, &c.,
Wm. A. Wyllis.

To the Secretary
Tidal Harbours Commission.

No. 420.
Income and Expenditure.

No. 420.

Return of Income and Expenditure for the Years 1842–3–4.

INCOME.										EXPENDITURE.									
Heads of Income.	1842			1843			1844			Heads of Expenditure.	1842			1843			1844		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Harbour dues . .	58	0	6½	90	0	0	65	6	0	Repairs and Works	274	16	2	283	11	7	233	15	10

W. A. Wyllis.

BALLANTRAE and DRUMORE.

No. 421.
Return to Order of the House of Commons of 9th Aug. 1844.

BALLANTRAE AND DRUMORE.

No. 421.

Return to Order of the House of Commons of August 9, 1844.

GENTLEMEN, *Rephad, March* 10, 1845.

IN answer to the communication which I had the honour of receiving from you some time ago, regarding the harbours of Drumore and Ballantrae, I am now enabled to state—

1st. Regarding Drumore Harbour:—

The harbour and small bay of Drumore are upon the west side of the bay of Luce, about four miles from the Mull of Galloway.

There is no Act of Parliament relating to this harbour. A small pier or landing-place was built at Drumore many years ago for local accommodation, and which has been exceedingly useful to the farmers in the neighbourhood: the works now belong to the Earl of Stair, and *persons using them pay small dues for the use of the works, little more than sufficient, in an average of years, to keep them in repair.*

I have no plan of the harbour, and am not in possession of any report on the harbour by engineers or other officers.

The situation and capabilities of Drumore Bay, however, render it particularly suitable for a harbour of refuge; indeed there are few situations where a harbour of refuge would do a greater extent of good, and where so small a sum would effect it.

The Mull of Galloway and adjoining bay of Drumore are in the direct course between Liverpool and Glasgow, and between the ports, on the coast of Wigtown, Kircudbright, Dumfries, Cumberland, and Lancashire, &c., on the one side, and the ports of Belfast, Glasgow, and the coast of Ayrshire on the other; and the bay of Drumore is the daily resort of windbound vessels from all these places.

The bay of Drumore is remarkably easy of access, and is sheltered from the prevailing westerly winds. It has also a peculiar advantage in respect of the tides, as the flow from the mull continues only three hours, while the current outwards is nine hours. This makes it remarkably easy to loose from, and induces vessels going up the channel often to run into Drumore merely to wait the tide northwards; as, from the above peculiarity in the currents, they can loose out from Drumore and be at the mull to catch the first turn of the tide.

The present harbour is, however, very limited in extent, and only the smaller coasting vessels take refuge in it. The larger vessels lie daily in the bay, but frequently, with strong south-easterly gales, they have been obliged to part their cables and run elsewhere; whereas, with an extension of the harbour, they would have taken it with these winds and been safe.

2nd. Regarding Ballantrae, which is also a creek in your district:—

You are aware there is no erection at Ballantrae, although a jutting rock, under the shelter of which small vessels come in, affords great facilities for erecting a harbour.

A harbour at this place would be very useful to the valuable fisheries of herring, cod, &c., on the coast, and also for the trade of the adjoining country; and it has also been considered by the best-informed people, that if the Irish packet station should ever be moved from Portpatrick, Ballantrae should unquestionably be adopted for that station; combining, as it may do, a short sea-passage with a speedy conveyance by railway from that point to Ayr, Glasgow, and Edinburgh, and possessing considerable natural advantages for a harbour.

A plan of a proposed harbour has been lately got by the Fishery Board, the estimated cost of which is 4800*l.*, and that Board has agreed to build the harbour if the half of that sum is raised by the fishers and others interested locally in the harbour. It is much doubted, however, whether these conditions can be met.

I am, &c.,
GEO. GUTHRIE.

The Collector and Comptroller of Customs, Stranraer.

No. 422.
Income and Expenditure.

No. 422.

Return of Income and Expenditure of the Harbour of Drumore for the Years 1841–2–3.

INCOME.										EXPENDITURE.									
Heads of Income.	1841			1842			1843			Heads of Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Tonnage and anchorge dues . .	50	0	0	50	0	0	57	0	0	Collecting dues and repairing harbour .	17	0	0	107	0	0	137	0	0

Private property of the Earl of Stairs.

JOHN SEMPLE, *Comptroller.*

LOCH RYAN.

No. 423.
Captain Beechey's Report on Loch Ryan.

LOCH RYAN.

No. 423.

Report by Captain F. W. BEECHEY, R.N., F.R.S., *on Loch Ryan.*

October 1, 1837.

LOCH RYAN has three places within its harbour which have been pointed out as fit stations for the packets, viz., Finnert Bay, Stranraer, and Cairn Ryan; but I should recommend the preference being given to the latter. It possesses an advantage over Stranraer, on account of its being nearer both to Glasgow and Larne by three-quarters of an hour each, which would make an hour and a half difference of time in the packet clearing the Loch; and over Finnert Bay, in consequence of that place being too exposed, and so situated as to require an enormous expense to render it a secure anchorage. Cairn Ryan, besides, with the aid of a low light-house upon the point, may be approached in the darkest night without hesitation; whereas Stranraer lies beyond an extensive spit, called the Scam, which would require a floating light in addition to the light upon Cairn Point.

In a memorial of the inhabitants of Stranraer, several objections have been urged against Cairn Ryan as a station, of which the rough anchorage, the violent tides, the boggy nature of the ground, in the event of a pier been required, and the limited space for the erection of buildings, are the most important.

I have considered all these objections, and do not think they obtain to any important extent. As regards the rough anchorage, the packets at either place, Cairn Ryan or Stranraer, will equally require the protection and convenience of a pier. The violent tides must be by comparison only, as they do not run more than two and a half knots per hour at Cairn Ryan, and are diverted from the position in which the pier would be placed, by the points of Cairn and Claddy. The ground off Claddy Point has been found to be clay, with a superstratum of sand and shingle, and there is sufficient space for the erection of all the stores and buildings that will be required upon Claddy Point.

The memorial goes on to state, that the pier already erected at Stranraer would be a great saving in the adaptation of that place to a station, whereas everything has to be done at Cairn Ryan.

This is in some respect true; but as the pier at Stranraer is dry at low-water spring tides, the advantage to be derived from its present length can be compared only to the distance at which the low-water mark at Cairn Ryan is from the high-water line; or about 220 feet of pier to be erected upon a foundation dry at low water.

In a letter of Mr. M'Neel, the collector of the customs at Stranraer, in answer to some questions which I put to him, he states that if Stranraer were chosen, an increase in the number of passengers might be anticipated; and that an advantage would be derived from an improvement in the trade of the place. But it appears to me that Stranraer offers no inducement for passengers to travel that route, except for the purpose of meeting the packet, and they would as readily go to Cairn Ryan if the station happened to be there; and that, unless Belfast were chosen as the station on the Irish coast, the packets would derive but little benefit from any increase of trade, as the articles exported from thence would not be shipped in the steamers, but continue to be carried by coasters, as at Portpatrick.

If Belfast should be chosen as the corresponding port with Loch Ryan, the immediate communication with that great commercial town would perhaps be of great benefit to the packets, by occasioning an increase of passengers, many of whom at present, objecting to the land conveyance to Donaghadee, adopt the passage by the Clyde steamers.

That passage is, however, a long and boisterous one in the winter, and they would no doubt be glad of the opportunity of going direct from Belfast to Loch Ryan. But this would not be affected by the situation of the station within the Loch, as it could not matter whether they were landed at Stranraer or Cair Ryan, provided they could find equally good accommodation, which would soon grow up at Cairn Ryan, as the demand for it became apparent.

Upon the whole, I do not perceive a single point in which the public or the mail conveyance could be benefited by fixing the station at Stranraer in preference to Cairn Ryan; but, on the contrary, there would be a disadvantage in point of time in the packet quitting the Loch, which in thick weather would be increased by the caution necessary to be observed in rounding the Scaur shoal.

Loch Ryan is a deep inlet ten miles in extent, accessible at all times, and one in which vessels may ride with all winds in perfect security. It may be approached with safety either by night or day, and with a moderate outlay might be rendered a highly desirable station for the mail packets to go from, on the Scotch side.

There are three places in the Loch which have been pointed out as eligible spots for the embarkation of the mails, passengers, &c. &c.; viz. Cairn Ryan, Stranraer, and Finnert Bay. Stranraer is at present the most secure anchorage; but as a pier must be built in the event of either being selected, this is of no consequence. A pier at Stranraer would be attended with less expense than at Cairn Ryan, and in a commercial point of view there are many reasons why that place would be preferable to Cairn Ryan; but on the other hand, there are some serious objections to it. The shoal called the Scaur would endanger vessels entering at night or in thick weather, and the mail would have to travel five miles farther by land, and the same distance back again by water, which would occasion an hour and a half's delay in the packet clearing the Loch; an interval sufficiently great to miss the Derry mail in its passage through Ballymena, by which a day's correspondence with the North of Ireland would be lost.

Finnert Bay is two miles nearer the entrance than Cairn Bay, but the anchorage is much too exposed to be frequented in its present state; and to render it a secure port would require very extensive and substantial works, which would far outweigh in expense the advantage of two miles only which would be gained by its adoption.

I have therefore no hesitation in recommending Cairn Ryan as the fittest spot in Loch Ryan for the station.

It has been stated in a memorial of the inhabitants of Stranraer, that the foundation in Cairn Bay is supposed to be boggy, and unfit for a pier; but I can find no good authority for such an assertion: on the contrary, it has been tried on an occasion of a vessel being dug out, and found to be solid clay; and our own experience in weighing in the roads confirms the experiment. The ground was tried, moreover, by one of the African's boats, by forcing a tube several feet into the ground, and examining the soil brought up, which was stiff clay, with a superstratum of shingle and stones.

On this head it does not appear that Stranraer has the advantage of Cairn Ryan; for the outer end of the pier erected there has sunk two feet from the line upon which it was originally built.

Another objection which has been made to Cairn Bay as an anchorage, is the rough riding vessels find there with a strong south-west wind, which has on several occasions forced vessels fom their anchors and driven them on shore.

A reference to the plan of Loch Ryan will show that the greatest fetch the sea can have in that port is five miles; and that about half way or less, there is the Scaur shoal to break, in some degree, any sea that could possibly get up in so short a distance.

Several vessels have, it is true, been driven on shore upon the beach of the Cairn; but Lieutenant Kelly has explained in a satisfactory manner how those accidents have occurred. It appears from the report

APPENDIX C.

LOCH RYAN.

No. 423.
Captain Beechey
Report on Loch
Ryan.

of that officer, that no vessel properly found in ground tackle, and well anchored, ever drove on shore during the five years that he has been stationed at the port.

The tides also are asserted to be violent at the Cairn; but I did not find them so. By our experiments they are only two and a half miles per hour at the anchorage, and were scarcely felt upon the bank in the situation of the proposed harbour.

Immediately off the Cairn Point, and between that and the Scaur, the stream ran somewhat faster; but this inconvenience, if it be one, would be more felt by the Stranraer steamer than the others, as she would have to steam against it a much greater distance.

The memorial states also that there is a want of accommodation at Cairn Ryan for storehouses and other buildings necessary to a packet establishment; but it will be seen in the plan that the level ground about Claddy Point will afford all the accommodation in this respect that can be required; and as regards any expense attending their erection, it seems to me that the ground may be obtained and houses built at less cost at Cairn Ryan than at Stranraer, where the space is already occupied by dwelling-houses and stores.

A mere extension of the pier at Stranraer to double its present length, as stated in the memorial, will not afford the requisite accommodation to the steam-packets, as the harbour when formed, being open to all steamers and sailing vessels trading to the place, will require to be enlarged accordingly. In its present state the pier is in general so occupied that a boat can scarcely get access to it.

I cannot, therefore, concur with the memorial, either in the objections to Cairn Ryan as a station or the advantages which Stranraer possesses over it; but on the contrary, I am of opinion that the situation of Cairn Ryan is so decidedly preferable, on account of its being so much nearer both to Glasgow and to the entrance of the Loch, that I do not hesitate to give it the preference.

In order to adapt Cairn Ryan to a station, it will be necessary to erect a pier for the purpose of landing and embarking passengers, carriages, &c.; for taking in coal expeditiously, and for ensuring the perfect tranquillity of the harbour. In my plan of this bay I have marked the situation which appeared the most advantageous for this purpose; it stands upon the bank, in from 12 to 14 feet water at low-water spring tides, and has its entrance to the northward well shut in from any sea that may find its way into the Loch by Cairn Point, overlapping the north-west point of entrance; it is also out of the line of the tides.

If such a pier as I have sketched were erected, a slip might be constructed within it upon which the packets might undergo any necessary repairs, and thus obviate the inconvenience of sending them to Glasgow or Holyhead for that purpose.

This situation has also the advantage of a stream of water, which might readily be conveyed in pipes along the pier for the purpose of filling the boilers with fresh water.

It will be necessary also to erect a low light-house upon Cairn Point; but this would be requisite in either case, and indeed is very much wanted under any circumstances.

Loch Ryan is a port of refuge for numerous shipping during the winter, and not less than 360 vessels have been wind-bound there in the course of that season.

The Corsewall light is an excellent guide to the entrance of the Loch, but there it ceases to be of use, and the navigator, in the dark, turns up the Loch, in dread of the Scaur on one side and of Cairn Point on the other, which having deep water close to it, gives no warning.

If there were a light upon this point, which has seven fathoms water within a stone-cast of it, a vessel might run boldly for it, and take her berth under it in perfect safety and in the darkest night. The light might also be made to serve the double purpose of pointing out the position of the point and of giving warning of a too near approach to the Scaur, by colouring the reflectors in a line drawn from the light-house to Cleughan Heugh on one side, and in a line leading to the eastward of the Scaur Point on the other. A light-house 18 or 20 feet high would be sufficient for the purpose.

In letter No. 19 you will find, Sir, the opinion of Mr. M'Neel, the collector of the customs at Stranraer, with regard to any improvement that might be expected in the trade of the port from fixing the packet station in Loch Ryan.

And in No. 20, the apparent advantages of Stranraer, and disadvantages of Cairn Ryan, of which mention has just been made.

No. 21 contains the opinion of Mr. James M'Kie, agent for Lloyd's in the south of Scotland, with regard to the ports of Cairn Ryan and Stranraer, in which he gives the preference to the latter. He speaks of the severity of south-west gales at Cairn Ryan, and states that vessels driven from that anchorage take shelter at Stranraer.

As I have not referred to this letter, I shall merely mention in this place that a vessel cannot run for Stranraer from Loch Ryan with a south-west gale, as the course is S.S.W. to the point of the Scaur, and W.S.W. afterwards; and for a vessel to reach Stranraer the wind must be well to the northward of west, in which direction from Cairn Ryan the sea has not one mile and a half fetch.

No. 22 is a letter from Lieutenant Kelly, R.N., referred to in speaking of the bottom at Cairn Ryan, and of the vessels which have driven from their anchors in that place.

No. 23 is also from Lieutenant Kelly on the same subject.

No. 24 contains the opinions of Mr. Oliver, who has been many years in command of a revenue brig on the west coast of Scotland. He considers Loch Ryan a safe port to run for, except in thick weather with a northerly gale, and that a light is very much required upon Cairn Point. He doubts the possibility of a vessel crossing from Loch Ryan to Larne in a heavy W.S.W. gale, but has no doubt but that the passage might be accomplished in a moderate gale by steam-vessels of the class of those at Milford. He also doubts the possibility of a steamer clearing Loch Ryan with a heavy north-west gale and flood tide. You will find also, Sir, the opinion of this officer on the safety of approaching Larne, and on making the passage across the north channel. He states also that Cairn Ryan is a safe anchorage, and that it rarely occurs that a communication with the shore cannot be kept up.

No. 25 contains the opinions of Sir J. Reed, Bart., commanding a revenue cruiser also; they are on the same subject and similar to those of Mr. Oliver, but more favourable to the port of Loch Ryan and to the passage across to Larne.

No. 26 was furnished at my request by the master of the Maid of Galloway, a steam-vessel trading between Stranraer, Whitehaven, and Belfast. It contains his answers to the same questions as were put to Sir J. Reed and Mr. Oliver. They are more favourable still to the port of Loch Ryan and the practicability of effecting the passage across to Larne at all times, and to the safety of approaching that port in all weathers.

APPENDIX C.

LOCH RYAN.

No. 423.
Captain Beechey's Report on Loch Ryan.

He states the average length of the passage of his vessel from Stranraer to Belfast to be five hours and a half, and that with a W.S.W. gale it might be seven or eight hours.

No. 27 is from Lieutenant Keily, R.N., and already referred to in speaking of the anchorage at Cairn Ryan. In this letter he states the reason why the steamers failed in getting round Corsewall Point and remained at Loch Ryan with a northerly gale, in answer to questions which I put to him in consequence of it being asserted that some steam-vessels had failed in their attempt to get out of the Loch with a northerly gale. This letter also contains a statement of the number of vessels which took shelter in Cairn Ryan in 1835 and 1836.

STRANRAER.

No. 424.

Return to Order of the House of Commons, of the 9th August, 1844.

STRANRAER.

No. 424.

Return to Order of the House of Commons of August 9, 1844.

GENTLEMEN, *Town Clerk's Office, Stranraer, March 19, 1845.*

WITH reference to the Secretary of State's circular dated 1st ultimo, calling for farther information respecting harbours, I beg to send you herewith a survey or chart of Loch Ryan, lithographed from the Admiralty plan by Commander Robinson, in 1829. And when I add that I am not aware of any reports made by engineers or other officers respecting this port or harbour, or any complaints made thereanent, I think I comply with the terms of the circular, so far as this harbour and port are concerned.

I remain, &c.,

WILLIAM BLACK, *Town Clerk.*

The Collector and Comptroller of Customs, Stranraer.

No. 425.
Income and Expenditure.

No. 425.

Return of Income and Expenditure for the Years 1841–2–3.

INCOME.				EXPENDITURE.			
Heads of Income.	1841	1842	1843	Heads of Expenditure.	1841	1842	1843
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d
Total income by dues	170 1 4	147 15 4	120 10 0	Repairs of harbour .	25 5 1	119 9 2	17 6 6

Dues levied by custom and authority of municipal corporation.

JOHN SEMPLE, *Comptroller.*

PORTPATRICK.

APPENDIX C.

PORTPATRICK.

No. 426.

Evidence taken on the 22nd Oct., 1846.

No. 426.

Examining Commissioner—Captain WASHINGTON, R.N., F.R.S.

Present:—Captain HAWES, R.N., Superintendent of H. M. Mail Packets; Mr. ALEXANDER M'NEEL, Treasurer and Secretary; Mr. J. MURDOCK, Clerk to the Commissioners; Mr. JAMES FINLAY, Resident Engineer; Mr. W. WALLACE, Mate of H. M. S. *Asp*; Mr. JAMES GILLESPIE, HUGH CRAWFORD.

[*Detailed plans of the harbour*, by Mr. J. FINLAY, *on the scale of* 20 *inches to a mile, showing the soundings, were laid on the table.*]

Mr. A. M'NEEL, Treasurer and Secretary, stated:—That the Harbour Commission was constituted under the Act 1 Geo. IV., cap. 112, (1820) which named 15 of the neighbouring landed proprietors as Commissioners; since that time 11 vacancies had occurred by death, which had not been filled up; three members form a quorum, and they all sign the minutes of meetings. Read the last minute of the Board and the Resident Engineer's report, containing representations as to the defects of the harbour, namely, the want of dredging and the removal of stones, which had been repeatedly transmitted to the Treasury.

The COMMISSIONER.—I have to request that copies of the last minute and of the Engineer's report may be transmitted to the Tidal Harbours Commission in London.

Mr. M'NEEL.—Copies shall be sent. Submitted accounts from the beginning of the Government works and furnished abstracts of the same—the total sum received from the Exchequer, including 10,000*l.* voted in 1843, was 170,601*l.* 15*s.* 9½*d.* The accounts are audited by the Commissioners and also by the Treasury auditors. There had been no occasion for correction in the accounts since the commencement in 1821. The secretary's salary is in arrear 7½ years. A collection was made at all church doors for Portpatrick in 1831. The passengers, &c., carried by the steamers yield an annual revenue of about 1000*l.*, and the number of letters assorted at Portpatrick post-office weekly, is about 6,600, but this is not above one-tenth part of the mails sent through Portpatrick; the mail-bags average daily about 6 cwt. But in judging of Portpatrick, it is not the present returns that should be looked to as a proper criterion of its merits as a packet station, but to what these might fairly be estimated at, were railway communication carried on there, and proper mail packets established.

The old pier of Portpatrick, which still stands good, was completed in the year 1774, at an expense, it is said, of 30,000*l.* Portpatrick is a very old and favourite packet station; for from a very remote period the mails were carried here in smacks, at the rate of 10*s.* 6*d.* a trip. Indeed, the great natural advantages of Portpatrick over every other place on the Scotch side, as a packet-station, are obvious and felt by all practical men from its proximity (and short sea-passage of 19 miles) to Ireland, and from the concurrent and favourable working of the tides in connection with the prevailing south-west gales; by which a vessel can in less than *one half tide*, cross over into comparatively smooth water on the weather shore, and thus secure a passage in all weathers; whereas from everywhere else in violent adverse gales, a *full tide* is run and the smooth water on the opposite coast is not yet attained. Nor is Portpatrick less favourably situated in north and north-west gales.

In *fogs* too, Portpatrick has a decided advantage over inland bays and low land, for here (at Portpatrick) with its deep water and bold coast, a vessel in the most dense weather can, by signal guns from the shore, fearlessly approach and enter the harbour with safety.

Mr. J. MURDOCK, Clerk to the Commissioners from its formation in 1820, when by Act of Parliament Portpatrick became a government harbour. His duty is to keep the minutes of proceedings. Submitted the original minutes duly signed by all the Commissioners present. Sir Andrew Agnew, Bart., is one of the Commissioners. Witness pays all workmen; in 1825 as many as 800 were employed; now only 25 men. His own salary is in arrear for 4 years. Has received the printed list of queries, and will supply written answers.

COMMISSIONER.—As far as a cursory inspection will enable me to judge, the minute and account-books are kept in good order and duly signed.

Mr. JAMES FINLAY, Resident Engineer on the works for three years. Before coming to Portpatrick was employed at Hartlepool for 9 years. Carried on works under Sir John Rennie on the Angelom works and at Glanford Brigg. Produces plans in detail of the harbour, with soundings taken by himself in 1846. Some sewers empty into Portpatrick harbour. A breach was made in the south pier-head in 1839, and great damage was done to the south-sea slope, both of which were repaired with great trouble. No dredgers had been employed in the harbour, but it had been deepened 15 inches with the spoon and bag; there is a certain filling-up from the sewers of the village; from seaweed, and from the soil brought down from the hills in heavy rains, but there is no great accumulation; the shingle on the beach is whinstone as are the rocks around. The stone with which the piers were chiefly hearted was brought from just to the southward of the harbour; in quarrying it the rubbish was shot through a gulley into the sea; is of opinion that this rubbish was not washed round into the harbour; one portion is a shingle and sandy beach on which vessels are laid to examine their bottoms. Prior to 1820 the only work here was the old stone pier, extending 200 feet in a N.E. direction, built in 1777; it is a nearly upright wall having only 5 feet batter and faced with ashlar freestone; it had a landing slip to seaward which has been washed away. A lighthouse 50 feet high was also built. In 1820 the new works were begun by running out the south pier 430 feet in a S.W. ½ W. direction, with a jetty projecting at right angles to the N.W. 75 feet; the sea-slope of the south pier extends up to the top of the parapet-wall, and was built at first with a slope of less than 1 to 1; all that part most exposed at the pier-head was washed away to the southward and filled up the angle. Till within the last 2 years a constant breaching of the glacis has been going on, from the outer point where the circular head springs, but the sea now appears to have formed its own slope. The stones laid down in the angle of the south pier were lifted by the sea, and served as battering-rams to breach the pier. The inner quay-walls have a batter of 10 feet in a height of 30 feet; they are built partly of freestone from the Clyde, Renton Quarry near Dumbarton, Anglesea limestone, and faced with Port St. Mary limestone. The lighthouse was built in 1834, and lighted till the heavy gale of 7th

APPENDIX C

PORTPATRICK.

No. 426.
Evidence taken on the 22nd Oct., 1846.

of January, 1839, since which it has remained unlighted, owing to the difficulty of access to it in heavy weather.

Mr. MURDOCH—In reply to questions from the Commissioner, stated that he believed the head of the pier was founded out of the straight line; as the works grew up above low water this was discovered, and the stones were set a little back in steps in order to regain the line, and thus it is believed they had not such a firm bearing one upon another as to enable them to resist the shock of the sea, and when in the gale of January, 1839, the waves came in very heavily the pier gave way.

Mr. FINLAY.—The works of the north pier were carried on at the same time. Henry was the first resident engineer employed on the works, and he was succeeded by David Logan in 1829. The foundations of the circular head of the north pier were laid by Henry, and brought up within 10 feet of the level of low water, and the jetty which projects at right angles to within 8 feet of the same level, and so they now remain. The south pier jetty was finished in October, 1831; the south pier in April, 1832, and was breached by the hurricane of 7th January, 1839: the width between the pier heads is 270 feet: if the works were completed the width of entrance between the jetty ends would be 170 feet. He would recommend to complete the north pier-head to 6 feet above high water mark, but to remove the north jetty, as it is in the way of vessels entering, and the inner breakwater answers the purpose of quieting the north harbour. There is a depth of 26 feet at the pier-heads at low water springs, which suddenly deepens outside and causes a heavy break of sea across the entrance in blowing weather; at the jetty ends the depth is 20 feet; between M'Cook's Craig and the old pier, or from Doran rock across to the end of old pier the depth is only 5 feet, and as little as 3½ feet a short distance farther in; this portion is called the bar, all of which should be removed to the depth of 7 feet at least, 8 feet would be better; to cut a channel 100 feet wide to a general depth of 7 feet at low water would require to excavate 11,000 cubic yards of soil; this might be done and carried away at 1*s.* per cubic yard, or at a total cost of 550*l.* The range of tide is 15 feet on springs, and 9 feet at neaps, or it rises on neaps to 12 feet above low water springs; a tide scale is placed at the north-east angle of the harbour, and the zero of low water is 2 feet 3 inches below the top of the landing of the stair in north harbour, or 22 feet below the top of the coping of south pier; a tide register has been kept for the last three years. There is a crane on the pier proved to lift 7 tons. After three years experience at Portpatrick is of opinion that the chief things to be done are:—1. To dredge the harbour, as recommended by Mr. James Walker, to a depth of 7 feet; and to remove the puddle dyke which runs along the whole length of the south pier, as well as the accumulation of stones off the old quay-end which narrow the navigable channel next to nothing, and cause much risk. 2. To build up the north pier and complete it to 6 feet above high water. 3. To excavate a tidal basin of 4 acres in extent at the east end of the harbour, which he would deepen to 10 feet at low water; with an 80 feet width of entrance. Has bored the ground and finds there could no difficulty in accomplishing it; it is clay generally with rock in parts; the site is of no great value; stone for the hearting of the works is to be had in abundance on the spot; the ashlar facing must come from the Clyde. He estimates that 45,000*l.* would do the work. A railway called the British and Irish Union is said to be about to be laid down to Portpatrick, but cannot say when.

Captain HAWES, R.N.—Has been 2½ years resident at Portpatrick as superintendent of H. M. packet service. Generally speaking the harbour may be taken without difficulty, except in very dark nights, in south-west gales, when, in its present state, it would not be prudent at all times to run in. Unless fine weather, vessels should not enter until there is water into the north basin, viz., after first quarter flood. The passage to Donaghadee can be made with great regularity. It is the nearest port on the Irish side, offering the shortest sea distance, and lying immediately opposite, the vessel has only to cross the tide and sea, seldom to directly contend with both. The Scotch coast is generally the lee shore, and gaining the first half of the voyage is the main difficulty, and which of course is sooner effected in this passage than any other, it being the shortest in this channel. Portpatrick having a clear, bold shore, with deep water home to the pier heads, no detention ever arises in thick weather or fogs; during the dense fogs in September last, when many steamers ran on shore in this vicinity, our packets made their passage at the usual average, and by means of a few signal guns and the bell, were directed into the harbour in safety, and without detention. There is certainly at times a heavy sea at the mouth of the harbour, particularly at the first break of the ebb tide, but in reality this has not seriously effected the working of the station. It is manifest the mails have been carried with great regularity, there being only four days in the last five years that the packet has not been able to put to sea and perform her voyage; and on an average, about three occasions a-year that she had to wait, from a swell of the sea at the entrance. In adverse gales loss of time occurs from want of power of the packets, which are only of 50 horse-power; and in heavy S.W. gales, from their inability to contend with the head sea in going out; it is necessary to stand on the pier and watch a smooth to direct them when to set on. A powerful steamer would pass out without difficulty. The shortest passage made by these vessels from quay to quay is 2h. 11m. The average in summer 2h. 35m., in winter 3h. 5m., and the longest in adverse gales 9h., but this does not occur more than once in the year. An efficient steamer would make the passage in 1h. 40m. The harbour in its present size, if deepened to 8 feet low water, would accommodate a vessel of from 110 feet to 115 feet long overall, sufficiently large for mail purposes only. Great inconvenience and some risk are felt from the foul state of the harbour; the old puddle dyke, which runs parallel with the south pier, and the accumulation of stones and sand off the old quay end, greatly narrow the channel, and the general silting up at the mouth of the north basin, which has formed a bar with only 3½ feet water over it at low water, is a serious obstruction, and makes it necessary, in order that the packet may sail immediately the mails are on board, to move her into the fairway or outer roads at half tide, which is a very exposed position, and placing her there in a dark winter's night is attended with some difficulty. The clearing and dredging of the harbour are therefore of the utmost necessity. A great run exists in the harbour in N.W. gales, which, striking against the old quay, is turned into the north basin, and obliges the packets to be securely moored. The erection of the north pier would, with a few minor alterations, tend to rectify this. Neither the round head to the north pier nor the proposed jetty should be built up: both would tend to produce a confused sea in the entrance. The deep water, 5 fathoms near the piers, could certainly be carried inland to form an extensive tidal basin, and it would be an important advantage to shelter the entrance of the harbour about three points, from S.W. by S. to W.S.W., leaving it open only in the direction of Donaghadee—distance 19 miles. No sea of any amount could arise from so short a fetch. Seeing what has been accomplished by these packets under difficulties, and from my personal expe-

APPENDIX C.

PORTPATRICK.

No. 426.
Evidence taken on the 22nd Oct., 1846.

rience on this coast during the last three winters, I am clearly of opinion that the passage between Portpatrick and Donaghadee can be made in a much shorter space of time, and maintained with more certainty and regularity, than between any other two points in this channel.

Mr. W. WALLACE, examined :—Is mate of the "Asp" steam-packet; the commander is sick and unable to attend. Has been 30 years at sea and 10 years on this station; during that period no damage has occurred, and has only missed making the passage one day in five years. Obliged to check the vessels round with hawsers in hauling out of the north harbour; at low water they strike on the bar, in blowing weather cannot venture to enter at low water but wait till half-tide; in foggy weather a bell is rung and a gun fired as signals. The approaches to the port are regular; vessels are never stopped by fogs. Loch Ryan would be more difficult to make. Six years ago the "Jane Gordon," of Ayr, laden with limestone, was wrecked north of the pier. The shortest passage made was 2 hours 3 minutes in 1833, the longest 11 hours 30 minutes on the 31st of December, 1833, in a gale from S. W. to N.W. It is the common practice in S. W. gales to set the lug sail and steer across till they make the Maidens, then steam up to Donaghadee in smooth water under the lee of the land; the first six miles are the worst of the passage. In S. E. gales they carry on till they get down as far as Gurnet Point. The vessels want power; they are only of 50 horse power and 97 feet long. Agrees with all former witnesses in saying the harbour wants to be deepened and the puddle dyke removed. This latter is very much in the way, as it extends along the whole length of the south pier at about 70 feet from it, and narrows the outer harbour about one quarter of its whole width.

HUGH CRAWFORD.—Foreman of works, and has been employed on them 11 years. Remembers the breach being made in the south pier in the heavy gale of 1839. A block of whinstone of 17 tons weight was laid down on the sea face of the south pier in 1835 and has since been moved by the sea. Concurs with all said by former witnesses as to the state of the harbour.

Mr. JAMES GILLESPIE.—Has been 50 years at sea and acquainted with Portpatrick from his youth. Agrees in opinion that this harbour is easy to take. There has been great improvement in the holding ground. Commanded a steamer from Stranraer to Glasgow for 10 years. Loch Ryan is a fine harbour; but could get out of Portpatrick this day in a heavy N. W. gale when could hardly have made the passage from the Loch. Last year the steamer could not sail from Loch Ryan when the mail packet made the passage. Deepening the harbour, removing the puddle dyke and making a tidal basin would be a great benefit to the place.

P. S. Among other instances of the value of the harbour, it may be mentioned that on the 24th October, 1846, the steam-packet at Portpatrick with the defective (50 horse) power, made her regular passage to and from Donaghadee in 3½ hours each way; while on the same afternoon the *Scotia*, new steamer of 80 horse power from Ayr, made Loch Ryan, but was unable to reach the shore, and, drifting from her moorings, she was obliged to keep steaming the best way she could through the loch during the entire night, without being able to effect a landing until 8 A.M. the following morning.

A. M'N.

An Account of Charge and Discharge between the Commissioners for Improving and completing the Harbour of Portpatrick, in Scotland, under the Act 1 *Geo. IV., cap.* 112, *and the Right Hon. the Lords Commissioners of Her Majesty's Treasury.*

Abstract of Income and Expenditure.

CHARGE.	£.	s.	d.	DISCHARGE.	£.	s.	d.
I. Sums received from the Exchequer, including 10,000*l*., voted in Session 1843, according to Mr. Walker's Estimate	165,442	0	0	I. Management, Postages, Travelling and incidental expences	18,093	8	8½
II. Interest accrued on balances	2,690	13	6	II. Machinery and materials .	46,292	18	8½
III. Receipts for furnishings and work to H. M. steam-packets at Portpatrick . .	337	10	1	III. Labour and workmanship (Day-work)	59,630	3	6¾
IV. Proceeds of sales of old materials and machinery .	2,131	12	2½	IV. Labour and workmanship (Measure and piece-work) .	9,631	12	10¾
				V. Houses and other buildings	1,360	11	7
				VI. Shipping and freights .	15,855	11	3
				VII. Rent on quarries . .	14,841	2	10½
				VIII. Purchase of lands and rents	1,490	16	6
				IX. Remuneration to Mr. Hull	500	0	0
					167,696	6	1
				Balance remaining in the Commissioner's hands, 12th October, 1846	2,905	9	8½
	£170,601	15	9½		£170,601	15	9½

ALEX. M'NEEL, *Treasurer*.

APPENDIX C.

PORTPATRICK.

No. 427.
Return to Order of House of Commons of 9th Aug., 1844.

No. 427.

Return to Order of the House of Commons of August 9, 1844.

Portpatrick, March 18, 1845.

GENTLEMEN,

IN answer to your communication of the 4th February last, requesting to be informed of such particulars as I can supply respecting the harbour of Portpatrick, and as are required by Mr. Manners Sutton's circular of the 1st February, calling for a "return" (in pursuance of an address of the House of Commons of the 9th August last to the Queen) "relating to the harbours and havens in the United Kingdom, stating the titles of the several Acts of Parliament, and Charters and Commissions under which the commissioners (or other persons) have acted and now act; also copies of all maps of the harbour or port in their possession, and of all reports made by engineers or other officers respecting the port or harbour, together with copies of any complaints made to the commissioners of the several harbours and ports of the defects of the said harbours;" I beg leave to inform you, with regard to the harbour of Portpatrick, that the authority under which the commissioners have acted, and now act, is the "Act 1 Geo. IV., cap. 112," intituled "An Act for improving and completing the Harbour of Portpatrick, in Scotland, so as to render the same a more fit situation for His Majesty's Packets."

I beg leave also, herewith to send you a map of the harbour and of part of the town of Portpatrick, in so far as the harbour works have been executed. With regard to reports made by engineers or other officers, respecting the port or harbour of Portpatrick, I must refer you to the eminent civil engineers, Sir John Rennie and Mr. Walker. As to any complaints made of the defects of the harbour and port of Portpatrick, I am not aware of any other than the general remark, which is obvious to all who are acquainted with Portpatrick, that, with such great depth of water at the entrance of the harbour, deepening and excavating inshore, for which there is ample space, as will be seen by the accompanying map, would render Portpatrick a most safe and commodious harbour, even as a harbour of refuge.

Portpatrick, from its proximity to Ireland, and from the peculiarly favourable working of the strong currents or tides, in connection with the prevailing winds, and from the great depth of water close inshore, has great natural advantages over every other locality as a packet station. It was chiefly these circumstances that in the year 1820, when the matter was referred to them, that decided the Elder Brethren of the Trinity Board, London, in favour of Portpatrick. And steam-packets have now been stationed at Portpatrick for the last twenty years; and although the harbour works are still incomplete, no accident, arising from the state of the harbour, has ever occurred to these packets during that long period. These packets have only 50 horse power; yet, for the last three years, they have, I believe, only once missed making a daily passage, which is generally effected in two hours and a half. But the harbour, which is capable of being deepened and enlarged by docks and otherwise, inshore, to any extent, at a comparatively small expense, is fit, in its present state, of accommodating steam-vessels of 100 horse power. And, besides, in the case of a general war, or of a civil commotion in Ireland, contingencies which it is to be hoped may never happen, but events, the bare possibility of the occurrence of which no Government is well entitled to disregard,—the *shortest sea passage*, as in the case of Portpatrick, and as a directly connecting link between the north of England and of Ireland, must, in a national point of view, be ever of paramount importance. For it would thus secure, by Portpatrick, a short, speedy, certain, safe, and economical sea communication between these kingdoms, in the most critical times and tempestuous weather, of *one hour and thirty*, or *one hour and forty minutes*.

I am, &c.,
J. MURDOCH.

The Collector and Comptroller of the Customs
of the Port of Stranraer, Wigtownshire.

No. 428.
Smeaton, on the capabilities of and improving the Harbour.

No. 428.

Report by JOHN SMEATON, Esq., C.E., F.R.S., *on the Capabilities of and improving the Harbour of Portpatrick.*

Austhorpe, May 18, 1770.

THE harbour of Portpatrick is generally esteemed the nearest port in Great Britain to Ireland, being, it is said, but about seven leagues from the harbour of Donaghadee, upon the coast of Ireland, and which is almost right opposite. On account therefore of the shortness of the passage, it becomes a very desirable object that the harbour of Portpatrick should be rendered safe and commodious for such vessels as are best adapted to carry the packets, passengers, carriages, horses, cattle and goods, between the two kingdoms; and on this head I am advised that nothing less than vessels of 40 tons drawing 8 feet of water, and constructed upon proper principles for sailing, will be fully adequate to this purpose.

This harbour of Portpatick is at present entirely in a state of nature, a small platform for the more commodious landing and shipping of passengers, &c. excepted; and indeed it has many natural advantages, being very easy of access, and of sufficient depth to ride the vessels proper to be employed afloat at low water, and to protect them from storms coming from seven-eighths of the whole compass; and had the remaining eighth been as well guarded as the rest, this harbour had been complete; but the want of protection from those points necessarily obliges the vessels employed to be of such a construction as unfits them for general purposes. Those defects it is the business of art to remedy, which is the object of the present proposition.

The harbour is formed by two ledges of rocks running out almost parallel from the shore, so as to form between them a small bay of about 220 feet clear width, and about 550 feet in depth, that is, in and out. The bottom is a clean sand, and the soundings gradually increase from the shore to 20 feet at low water in the mouth of the bay, and leaving from 9 to 10 feet at dead low-water mark in the middle of the harbour.

APPENDIX C.

PORTPATRICK.

No. 428.
Smeaton, on the capabilities of and improving the Harbour.

The coast of Ireland lies right in front, extending from S.W. to N.W., and being so near as not to admit of any considerable swell; with the wind right in, it becomes naturally defended from the western quarter from the N.W. and W. points, the Mull of Cantyre, &c., and being lastly very well screened by the ledge of rocks immediately on the north side of the harbour, which rise considerably above high water, no considerable violence is experienced on that side. The land lies from N. to S., so that nothing can happen from the eastern point. It is therefore only from S. to S.W. inclusive that the harbour lies unprotected.

The ledge of rocks on the south side of the harbour, which runs out in a direction W. by S., and nearly points towards the light-house of Donaghadee, would, from its position, afford a considerable shelter in all those winds if it were higher; but the Irish Sea being open from these points, and the rocks being in a great measure covered at high water neap tides, and at three fourth floods at spring tides, the seas break over them with so much violence in time of storms, that vessels lying there are obliged to be suffered to beat up upon the sandy beach at the bottom of the bay, and to be retained by ropes as the only means of protection. This in consequence not only creates a great deal of trouble in hauling them up, and launching them after the storms are over, but obliges them to be made so strong, and of so flat a construction, that they will not sail except with the wind on the beam or at aft. As, therefore, all the westerly winds prevent their sailing from Portpatrick to Donaghadee, and all the easterly from returning, it follows that they cannot regularly go and return except the winds are southerly or northerly, nor indeed could they go very well with those were it not for the very strong current of the tides, which set up and down this narrow channel between the two kingdoms, twice each way in a day, so that by sailing at a proper time of tide they are prevented by the current from sailing to leeward; but could vessels constructed upon proper principles for sailing be protected here from all points, they would be enabled to turn to windward, and consequently make their passage good in all winds when the weather is moderate, from the great advantage that arises from the particular set of the tides. Now as this harbour, in its present state, would be very convenient for the purpose, being open and deep, and easy of access and departure, were it not on account of the effects of violent winds from one-eighth part of the compass only, as before mentioned, the place itself being small, it must be a principal care that while we are providing against the above-mentioned difficulties we do not destroy its natural advantages.

With this view I propose to run out a pier from the point of the rocks upon the mainland at A., fig. 1, plate 24, and crossing the gully between that point and the detached ledge of rocks, hitherto called the south ledge, to follow the general direction of the same, and to terminate the pier at B., as particularly shown in the plan. This pier to be raised 6 feet above the high water of a spring tide with a parapet of 6 feet upon that, so that the whole being raised 12 feet above high water will effectually screen the vessels from the south and south-westerly winds, and greatly mitigate those nearer the west; and so far as this goes the benefit to be obtained will be attended with no disadvantages in other respects, that I can foresee; and it is possible this being first executed the internal pier may be found unnecessary; but as the north point of Strangford Bay on the coast of Ireland is the southernmost, bearing from Portpatrick, viz., S.W., and ¼ W., I am of opinion that so much sea will get round the head as to reduce the space naturally screened thereby into so narrow a compass, that vessels properly built for sailing will not safely ride in the harbour with the wind in such a position as may be judged of by considering the position of the slaice upon the plan, marking out the bearing of the north point of Strangford Bay.

It seems, therefore, necessary to provide a place of safety at such times, which I propose to effect by means of the interior pier, (C. D.,) the position of which I have endeavoured so to adapt as to be sufficiently capacious and deep without taking up any part of the external harbour, where I apprehend the vessels usually ride. This would certainly have been the case had this internal pier been carried farther out, so as to have been capable of admitting vessels drawing 8 feet at low water. As it is, all the space is preserved where they cannot in ordinary float at low water, and vessels will be capable of going in and out of the external harbour at all times except from three-quarters ebb to one quarter flood, and during this space of low tide the seas will be so mitigated by the projection of the rocks upon the neighbouring coasts, that a vessel may safely ride in the external harbour till the water flows sufficiently to let her go into the internal. It is true that as the vessels in the internal harbour will be obliged to take the ground, they will be required to be strongly timbered; but as they are not intended principally to carry weight that will not hinder their external form for being adapted in the best manner for sailing, it being the case with few harbours the most resorted to in Great Britain, that vessels can ride afloat at low water.

The flow of the tides at Portpatrick is said to be 15 feet at spring tides, and 12 feet at neap tides; but, like other places, variable according to the winds. When I was there, which was on the 11th October, 1768, being the day after the new moon, the perpendicular flow was only 10 feet, so that at a 15-feet spring tide, the water would ebb out 2½ feet lower, as appeared by a mark pointed out to me, and flow 2½ feet higher. According to this state of the tides, the internal pier will be placed at 4½ and 5 feet water at low-water spring tides, and will have 19½ and 20 feet at high water; and at such a tide as I saw, (which was less than an ordinary neap tide,) 7 and 7½ at low water, and 17 and 17½ at high water, so that it is evident vessels will be always afloat within the internal harbour, whenever it is a proper time of tide to go out, there being always 12 feet water at half tide.

This internal pier being at all times greatly sheltered from the violence of the seas by the external one, it is proposed to be considerably thinner on that account, and its body not raised so high by 2 feet, so that its top will be lower in the whole by 4 feet, that is, it will be only 8 feet above high water spring tides; yet this it is presumed will always be fully sufficient to resist any seas that can get round the head of the external pier.

Since I have proposed the internal pier as a place of refuge, it may be reasonably inquired why this may not do without the external one? To this I must observe that it is only so much of the external pier as projects beyond the internal one that is the object in question, and this will be built with so much advantage to a proper height, by being upon the rocks, that if omitted, the internal pier will be required of greater base, height, and strength, and thereby the cost of the external one will, in a great measure be incurred.

2nd. The vessels will be protected in the external harbour with wind at S. and S.S.W., and therefore can come in and find shelter at a time when the tide would not serve to go into the internal harbour, and also will so far moderate the seas at S.W. as to enable the vessels to wait till they can get into the internal, and in all southerly winds will enable vessels to get under way going out, and to come to on entering, which they could not venture to do either from or to the entry of the interior harbour.

No. 428. Smeaton, on the capabilities of and improving the Harbour.

3rd. If the seas were not first moderated by the external pier, so much sea would get round the internal as not to admit vessels to lie there with sufficient quiet, unless it were so far contracted at the entry as to make it difficult of access and departure.

Within the internal pier the vessels may occasionally take in their freights; but as I apprehend, the place of the present platform will be found in general the most commodious, especially about half tide, I propose that platform to be extended, and the face of the rock to be extended by blowing off the irregularities, according to the line E. F., and if the rock G. and part of the rock H. I. to that line be blown up to the level of the sand, it will be the means of preventing damage to vessels within, and of entertaining a greater number of vessels, for when this is done the interior harbour will be capable of holding on occasion ten or fifteen sail, from 40 tons downwards.

Respecting the construction of the piers, as the coast is all rocky, I propose to make all the use that properly can be done of the stone that the place affords, but it happens to be of a kind not very well adapted for this sort of work, except for fillings, rough basements of such parts of the piers as are not built upon the rocks; and to these uses I propose to confine it. The stone composing the two ledges of rocks on each side of the harbour is of a very hard but very flinty nature, which seems a good deal the case with the stone I see thereabouts, so that it can hardly be got without gunpowder, which would be apt to shiver it into small pieces. I observed that a considerable quantity of large loose pieces that had tumbled from the cliffs might be collected, enough to form the basements of the piers, as marked out in the sections, plate 23; but as it does not appear that a sufficient quantity could be collected to do the whole with rough materials, which would, if so constructed, be required to be still more bulky, I propose to face the upper part of this pier with quarried stones, scapelled to somewhat of a square form, to be disposed as shown in the sections, and to be filled with rough materials, to be obtained from the rocks in the neighbourhood. I did not, indeed, see any stone in that part of the country fit for facings of the kind I propose; but as this part lies open by sea to a considerable extent of coast of England, Scotland, and Ireland, it is not to be doubted but that convenient quarries will be found from which proper stone can be brought by water; and for this purpose I have made a consideration of 2*s.* 6*d.* per ton, that will be about 2*d.* per cube foot, which allowance I judge fully sufficient.

It is further to be observed that I propose all the rough bases and fillings to be composed of as large stones as can easily be procured near the place, and no stones of two tons or under be broken on account of removal, and that the fillings be at a medium, about a cube foot in a piece, the smaller being disposed in the interstices. The whole to be built dry, except what is particularly specified in the estimate to be done with cement or mortar.

It has been observed to me that a considerable rivulet can be turned into this harbour. This may be of great use in case the interior harbour should be found inclined, from a greater degree of confinement, to retain more sand than it does at present, and will prove an effectual remedy to every evil that can arise from that circumstance. At present, the harbour does not retain more sand than one would wish it to do for the safety and ease of vessels.

J. SMEATON.

No. 429.

Reports which have been made by JOHN RENNIE*, Esq., Engineer, *to the Irish Government, the Treasury, or the Trinity House, relative to the Improvement of the Communication between Ireland and Scotland by the North.*

No. 429. Rennie, on the formation of the Harbour.

SIR, *London, December* 23, 1817.

I DULY received your letter of the 5th of November last, with an enclosure from the Right Honourable Robert Peel to the Postmaster-General, relating to the packet-harbours on the Scotch and Irish sides of the Channel, and also your letter of the 15th of the same month, desiring me to select one place on each side of the Channel, which, from the survey of the coast, I may consider as the best suited to the purpose of forming a permanent packet-station for the conveyance of the mails across the said Channel. In consequence of the foregoing directions, I set about the business as soon as the plans and surveys were returned to me, which was early in the present month, and I had gone through the information contained in the surveys relating to the tides, currents, winds, &c., and also the evidence which had been taken from time to time on the subject, together with my own notes and observations made in the course of my examination of these respective places, when your letter of the 19th inst. came to hand. Since then I have carefully examined the plan sent therewith, and read over the letters of the Right Honourable Robert Ward and D. Kerr, Esq., with the papers to which they refer, which, with those already in my possession, form a very voluminous body of observations and evidence, though in many cases very contradictory, of what ought, in my humble apprehension, to be plain facts. The surveys and notes in my possession are sufficient to disprove some of the former surveys and observations; but there are many points relating to professional seamanship, which I do not reckon myself competent to decide upon.

The mode recommended by his Excellency the Lord Lieutenant is certainly by far the most judicious mode of proceeding; namely, to report in the first instance on the best places as permanent packet-stations, and, when these places are decided, to make out suitable designs for harbours. This mode I am quite certain will prove much more satisfactory to His Majesty's government than anything I could singly do, and will be attended with the most beneficial public advantage; but although the confidence his Excellency has been pleased to express of my professional skill highly is gratifying to me, I humbly beg leave to state that I should betray that confidence if I took on myself to decide on professional points of seamanship, in which neither my experience nor skill is equal to others who have made it the study of their lives; and as most of the evidence that has been taken is from those who, it is clear, have had their minds warped by local prejudices or interests, without in any degree meaning to state what they believed to be contrary to the truth, I beg leave to recommend that the selection of the proper places for packet-harbours be referred to unbiassed

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* TO THE READER.—This Report was by old John Rennie; some of the others, as marked, are by *Sir* John Rennie, his son.

No. 429.
Rennie, on the formation of the Harbour.

and competent persons, thoroughly acquainted with navigation and seamanship; and for this purpose I apprehend no set of men are better qualified than the Elder Brethren of the Trinity House in London, who I am sure would readily undertake the business on an application being made from the Treasury; and if all the papers were to be referred to them, I should be most happy to attend to give them every information I possess; and should their decision be approved of by the Government, the designs for suitable harbours would soon be completed.

I am, &c.,
JOHN RENNIE.

Edward S. Lees, Esq., Post Office, Dublin.

SIR, *Stamford Street, April* 30, 1818.

I HAVE received your letter of the 11th, enclosing Mr. Court's letter to you of the 10th, wherein you request, for the information of the Right Honourable Robert Peel, my opinion as to the best and most economical plan of giving effect to the wishes of the Elder Brethren of the Trinity House. In answer, I beg leave to say that I know of no mode so economical, speedy, and correct, as that of employing Mr. Francis Giles, who made the former survey, to do this part also; because he has already surveyed the whole outline of the coast, and has all his stations fixed to which the position of the soundings will have to be referred. These outlines and stations would require several weeks of a new surveyor to fix; and although the distance of Donaghadee from London is considerable, as well as the expense of Mr. Giles travelling, yet the saving of time which will arise from the employment of him will more than compensate for the difference of expense.

I remain, &c.,
JOHN RENNIE.

Sir Charles William Flint, Irish Office.

SIR, *Irish Office, London, May* 20, 1819.

I AM commanded by the Lord Lieutenant to send you enclosed a copy of a Report made by Mr. Rennie to the Postmaster-General of Ireland, together with the three plans therein referred to, relative to the construction of new piers at Donaghadee and Port Patrick, with a view of rendering the communication between Scotland and Ireland more commodious; and I am to desire that you will lay the same before the Lords Commissioners of His Majesty's Treasury for their consideration and approbation, before those documents shall be submitted to Parliament, for the purpose of obtaining a grant of public money, in the present session, to commence the proposed works.

I send you also a copy of a paper, signed by the commanders of His Majesty's packets on the Donaghadee and Port Patrick station, and by certain masters of vessels plying between those ports, stating their opinions in favour of the plans given in by Mr. Rennie.

I am, &c.,
C. GRANT.

George Harrison, Esq., &c. &c.

MY LORDS, *London, February* 19, 1819.

IN consequence of directions received from your secretary, Edward S. Lees, Esq., by letter dated the 14th of November, 1814, the purport of which is to the following effect, namely, that a plan for the improvement of the intercourse by correspondence with North Britain had lately been submitted by their Lordships the Postmasters-General to the consideration of the Lord Lieutenant, and had received his Excellency's approbation and sanction.

The most important part of this plan, which their Lordships thought it their duty to recommend to the attention of government, was "the improvement of the packet-harbours, either by extending the present piers of Donaghadee and Port Patrick, or by erecting new ones in other positions, if such can be found, in either; I am commanded to observe to you, towards giving full effect to their Lordships' arrangements, it is essential, and indeed indispensable, and they request me, under their authority, to cause plans and estimates of such alterations as you may deem practicable on the present harbours of Port Patrick and Donaghadee to be forthwith made for their consideration, having in view that these alterations are to be of such a nature as, when effected, shall at all times render both harbours independent of the tide, and that at the Scotch side the obstacles which so frequently occur in Port Patrick by west and south-west winds may be overcome.

"Their Lordships consider that, under all circumstances through the year, in point of local position, Donaghadee and Port Patrick are the most eligible permanent stations for His Majesty's packets, but they by no means wish to confine you in your inquiries to these places, but are desirous that all other places on both coasts, not proceeding however on the Irish side of the Channel more northern than Bangor, or more to the south on the Scotch side than Ardwell Bay or Port Neesock, may be viewed; and they will be anxious to obtain your opinion on the comparative expense of thus altering and improving the existing harbours of Donaghadee and Port Patrick and Bangor, and of forming new ones at Ardwell Bay and Port Nessock."

The above directions embraced so wide a field of inquiry, and over such an extent of coast, that it became necessary not only that the whole should be viewed, but that surveys should be made of all places where there appeared a probability that a harbour could be constructed; but this was not all, for, even admitting that a place or places on each or either side of the Channel were found where packet-harbours could be established, it became farther necessary that the sets of the tides and currents should be ascertained, in order that the eligibility of a harbour at any one of such places, for the use of His Majesty's packets, might with confidence be recommended, as also the practicability of junction roads from the great roads leading to and from the metropolis and principal towns in the respective countries. I was therefore obliged to employ surveyors for that purpose, which, owing to the badness of the weather, occupied nearly the whole of the year 1815. When these surveys and plans were completed, investigations of a nautical sort became necessary, as also attending to the representations from various proprietors of lands on either side of the Channel, who were desirous of having the packet-harbour established on their property; these together formed such a mass of materials that it became very difficult to decide in such a manner as to do justice to the public amid so many conflicting interests. The Lords Commissioners of the Treasury therefore very wisely

APPENDIX C.

PORTPATRICK.

No. 429.
Rennie, on the formation of the Harbour.

decided that the whole of the surveys and materials collected by me should be submitted to the consideration of the Elder Brethren of the Trinity House; and accordingly I was directed, by Mr. Harrison's letter of the 9th of February 1818, to lay these plans and materials before the corporation who, after due consideration, decided that on the Scotch side the harbour of Port Patrick was, in their opinion, preferable to any of the other places surveyed; but they hesitated as to the best situation on the Irish side, until some further surveys were made in places that were pointed out by them. These surveys were in consequence made and submitted to the corporation, who, on the 6th of October last, gave their opinion in favour of Donaghadee, as the most suitable place for a packet-harbour on the Irish side of the Channel; but absence from London at that time, and urgent public business since, prevented me, until lately, from making out the necessary designs and estimates.

It appearing from the respective Reports of the Corporation of the Trinity House, that Port Patrick and Donaghadee are in their opinion the two most eligible places for packet-stations, I shall confine myself to making such plans, estimates, and reports on these two harbours, as appear to me best suited to the purpose, as I have no doubt the Elder Brethren have fully weighed the advantages and disadvantages of these two stations, under all the circumstances of tides, currents, and the prevailing winds of the country. It would be presumption in me to enter into a discussion on topics in which my knowledge is so limited when put in competition with theirs; but it will be necessary that in the formation of the respective plans I should keep in view these matters, so far as may render the harbours I shall submit for consideration as easy of access from the channel as possible, with a certainty of the packets sailing from them whenever the wind and weather are such as they can with safety make their passage across the channel. It must not however be expected that a harbour can be constructed at either of these places which will not be liable to some objections; all that can be done is, to construct them in such a manner as that the objections may be as few, under all the circumstances of the case, as the nature of the situation will admit at any reasonable bounds of expense. If I shall succeed in this object, my pains will be well bestowed.

PORTPATRICK.

Spring tides usually flow about 13 feet at Port Patrick, though at times with particular winds they rise higher; 13 feet may, however, be taken as a full average. Neap tides usually flow from 7 feet to 7 feet 6 inches; and as spring tides generally flow as much higher than neaps as they ebb under them, the high water of neap tides may be taken at about 10 feet above the low water of spring tides, and the soundings on the plans are taken at low water of a 13 feet 3 inch tide. It is high water at full and change of the moon at eleven o'clock; but the best tides flow about three-quarters past twelve. The time of flood and ebb are nearly the same, though on the whole the time of flood is rather less than that of ebb. The flood tide, therefore, has rather a stronger current than the ebb tides.

The flood-current makes along the shore about an hour and a half before low water, and runs to the southward until within about two hours of high water; it then runs northward, and continues so until within about an hour and a half of low water. The flood tide in the channel makes to the south-east about an hour before low water, and continues in that direction until within about an hour of high water. The separation of the inshore and channel tides is distant about a quarter of a mile from the harbour; and at this place the rate of flood-current is about two miles and a half in the hour.

The prevailing winds are from S. S. E. to W. S. W. The south winds occasion the heaviest swell in the bay, but the present harbour is mostly exposed to S. W. winds; and in fact, the harbour may be said to be shut up in all winds from the S. S. E. to W., which is eleven points, if they blow strong, but if moderate, vessels can warp out in some of these winds, and in others they can sail out; indeed, Catherine's Isle enables them to sail out in S. S. E., S. by E., S., and W. winds; so that, except the winds blow very fresh, the harbour may be said to be shut up in only seven points of the compass.

In winds blowing from the S. S. E. if moderate, and even sometimes when blowing fresh, the vessels make a line fast to one of the rings at the outer end of Catherine's Isle, by which they are hauled out; in this position they will be S. W. by S. and at least 5¼ points free of the outer end of the Black Isle Rock; consequently, they have 5½ points to work on in clearing the bay, and which is accomplished by the time the vessel has stretched a course five times her own length.

In moderate S. by E. winds, a vessel is in like manner hauled out to near the extremity of Catherine's Isle Rock, and lies S. W. which is 4½ points free of the outer end of the Black Isle Rock. In this case she has 4½ points to work upon to clear the bay, and which is effected in the distance of five times her length.

Vessels leaving the harbour in a south wind are in like manner hauled out to the extremity of Catherine's Isle, where they lie S. W. and by W. full 3½ points free of the Black Isle Rock, so that they clear the bay in about five times their own length; and the same may be said of moderate west winds.

At the first of a breeze from the S., S.S.E., or west winds, vessels lying afloat frequently sail out with two and three reefs in their mainsail by the means before described, when it is prudent to go to sea at all; and being once out, they fall in with a strong tide at the distance of about a quarter of a mile from the harbour, and, having sea-room, they beat to windward across the channel. Although, therefore, the harbour is shut up by winds blowing from the points I have named, yet in moderate weather, from any of these points, if the tide admits of their getting out of the harbour by a warp, they beat their passage across in twelve or fourteen hours; but owing to the harbour within the present piers being a tide harbour only, the packets are frequently prevented from taking the advantage of warping or sailing out at the proper time, and consequently of making a passage; and indeed, if the wind blows fresh, they are shut up in the harbour for days, and even for weeks together, as they are in great danger of being wrecked when exposed without the pier.

Vessels do not leave the harbour when the wind and channel tide are in the same direction; if they did, they would be carried several miles to leeward, and out of the track to Donaghadee. The time of tide to be preferred is generally the first both of flood and ebb, as the direction of the wind may render it advisable. The great object therefore to be attained is to construct a harbour at this place where packets may always lie afloat, ready to take the advantage of wind and tide whenever it may suit them to make a passage, and that they may be carried so far out into the channel as to

APPENDIX C.

PORTPATRICK.

No. 429.
Rennie, on the formation of the Harbour.

enable them to make sail from the pier-head, without the line of the Black Isle Rock and David Dickeys; or in other words, that they may get into the open channel whenever they sail out of the harbour's mouth. With this view I have made out two designs, one for a harbour on a small scale, and another for a harbour on a larger one.

The design for a harbour on a small scale is exactly on the same principle as that for the larger scale; each design has piers that extend beyond the line of the Black Isle and David Dickeys Rocks; but the one has a greater extent of deep water in it than the other, consequently affords more room for vessels to bring up, and for the waves to expend themselves, by which it will be much safer to enter, as well as more quiet within. Besides, by vessels being further to leeward before they cast off from the pier, they will sooner get into the channel tide, as well as be a greater distance from the rocks alongshore. Although, therefore, the expense will be much greater, its advantages, in my estimation, are greater than the difference of expense.

The smaller plan consists of a pier extending from the pier at the present lighthouse, along the top of the ledge of rocks and the top of Catherine's Isle, terminating about 35 feet beyond the extremity of this isle. About 60 feet within the head of this pier a jetty is proposed to be made, of about 60 feet in length, the end of which will terminate about 20 feet beyond the extremity of the rock, in about 12 feet water. The rock within this pier and jetty is proposed to be quarried away to the same depth, so that there will always be 12 feet water at low water of ordinary spring tides, and about 11 feet in the lowest ebbs.

I propose to construct a similar pier with a jetty on the north side, from the high rocks on the shore, along a ridge of rocks which lies to the south of the Black Isle Rock, having an opening for the tide to pass through, and extending about 120 feet beyond the rock, with a jetty 70 feet long, and leaving an opening of 180 feet wide between the jetties, whereby a small inlet north of M'Cook's Craig will be sheltered, and in which packets may lie under cover of the jetty in winds from south-west and by south to north-west, as they will in like manner lie under the shelter of the jetty of the south pier in winds from south-west to south-south-east, so that vessels will lie in safety ready to proceed to sea when it is prudent to do so in all those winds which now shut up the harbour. To make free room, however, for vessels taking shelter under the jetty of the north pier, it will be necessary to remove the half-tide rock, and perhaps part of that adjoining M'Crook's Craig, as also to quarry away a part of this rock in such manner as to throw the waves more into the present harbour, in order that they may leave the little inlet I have described as smooth as possible.

The expense of the harbour I have described will, according to my estimate, amount to the sum of 87,550*l.*, as will appear by the annexed estimate, exclusive of a lighthouse, which will cost about 4500*l.* more, as it should be on a scale sufficient to mark out the entrance distinctly.

In the larger plan, the piers are further extended to seaward, where the water is deeper, and the jetties are larger; the half-tide rock, in this case, will not have to be quarried away, but may remain as a breakwater to prevent the sea running into the inlet, which will be sheltered by the jetty, and thus render the water more quiet. It will, therefore, not only be easier of entrance and exit, as I have before said, but, the water having more room to expand within, it will be more quiet; vessels in going to sea will be sooner in the channel tide, and farther distant from the rocks on the shore, so that it will be much more safe and better adapted to the purpose than the smaller harbour. The expense, however, will be greater, as appears by the annexed estimate, amounting to 115,280*l.*, exclusive of the lighthouse 4500*l.*, being an excess of 27,730*l.* This excess arises from the extension of the piers beyond the rocks, and their being built in deep water, which is no less than 21 feet at low water.

DONAGHADEE.

Donaghadee lies west and by south from Port Patrick, and is distant from it about 21 miles and 5 furlongs. Spring tides usually flow at this place somewhat less than at Port Patrick. The average of spring tides, from the 26th of March to the 24th of May, was only 12 feet 3 inches; these, however, being the equinoctial tides, exceed the usual flow. I apprehend 12 feet may be taken as a fair average spring tide. Neaps may be taken something more than 7 feet; the low water of a spring tide of 12 feet 3 inches rise was however taken as the data for the soundings laid down on the plan. High water at neap tides will, therefore, be about 9 feet 6 inches above low water at spring tides.

It is high water full and change of the moon at eleven o'clock, but the best tides flow about twelve.

The currents of the tides are here very different from those at Port Patrick, owing in part to the Copeland Isles, which lie north-east from the harbour, the nearest of which is about a mile and three-quarters distant from it; and owing to the Lough of Belfast, which occasions a great indraught from the main channel, while the tide is flowing with a proportionate discharge during the ebb, the time of flood and ebb are nearly the same, though on the whole the time of ebb rather exceeds the time of flood.

The flood-current makes to the southward alongshore about two hours before low water, and continues in this direction until dead low water; it then runs to the northward, and continues in this direction until within two hours of low water; so that there is only two hours of south current in the rise and fall of the tide, and ten hours north current.

The channel between the largest of the Copeland Islands and the main land is called the Inner Sound, and that between the large and small Copeland Isles is called the Outer Sound; the direction of the tide in both these sounds near to Donaghadee is nearly the same. In these sounds the flood-current makes to the southward about 1½ hour before low water, and continues running southward to within two hours of high water; it then turns northward until within 1½ hour of low water, so that in the sounds there is about 5½ hours south current, and 6½ hours north. Besides the tides I have described, there is an east or off-going tide, which sets south about 1½ hour before low water, and continues in that course for about three hours, or to about 1½ hour after low water; it then sets S.E. by S. to within 1½ hour of high water; at this time it changes its course and sets north to the distance of about three leagues from the shore for 4½ hours at spring tides, or to three hours after high water; the channel tide then makes on it, and changes its course to W.N.W. until within about one hour of low water, so that this east or off-going current has nearly six hours flood, and something more than six hours ebb; but they have the various directions I have described in the course of the twelve hours.

APPENDIX C.

PORTPATRICK.

No. 429.
Rennie, on the formation of the Harbour.

The velocity of the currents is so variable here that it is scarcely possible to lay down any stated rate; the strongest of the flood-current is between one-half and two-thirds flood, and the strongest of the ebb is between one-half and two-thirds ebb.

The prevailing winds of the country are in favour of Donaghadee, as Port Patrick is nearly N.E. by E. ¼ N. of it by meridian, or nearly N.E. by compass. This harbour is therefore not shut up by winds so frequently as Port Patrick, nor is it so much exposed; the adverse winds are included within 7 points of the compass, namely, from N.E. to E.S.E.; but in moderate weather, and at spring tides, the packets beat out with either of these winds, and effect their passage in from eight to fourteen hours, providing there is sufficient wind. In all the other twenty-five points of the compass, they sail out and make their passage with ease; but if the tides are at neap they cannot easily beat out when the winds blow from any of the points I have mentioned as adverse, namely, between N.E. and E.S.E., as there is not sufficient depth of water to work between the Dulee Rocks and the pier and rock south of them. The harbour of Donaghadee therefore, though not so bad or so much exposed as that of Port Patrick, is a very imperfect harbour, and wholly inadequate to the purpose of His Majesty's packets; it is true the prevailing winds are in its favour, and this principally gives it the superiority of the other; but unless a depth of water to keep the packets afloat at all times of the tide be made, the evils of this harbour cannot be removed.

I have tried various plans for the improvement of this harbour; but it does not seem to me that anything effectual can be done on a moderate scale. It is true, the rocks called the Dulee Rocks might be removed; but this would only give more room for vessels to work to windward when the tide would suit, but not at low water, as they lie aground within the present pier; and besides, the removal of those rocks would render the present harbour less secure, as they form a kind of breakwater to defend its mouth. A harbour cut out of the rocks lying to north-eastward of the present pier would not only be on a small scale, with a want of sufficient depth of water at the entrance for vessels to work out of it at low water, but in all probability would in a short time be filled with sand and mud. A scheme of this sort, therefore, appears to me quite inadequate to the purpose; and indeed all harbours on a small scale, without a large breakwater, or a current passing through them, are liable to become more shallow, if not absolutely to be choked up. I therefore think it right to abandon all idea of a harbour of this sort. The plan that appears to me preferable, under all the circumstances of the case, is to build a pier on the rocks from the watchhouse, about 430 feet outwards in a straight line, with three kants of about 100 feet in length each, the last forming the head or entrance, and which is proposed to extend beyond the extremity of the rock called the Rush Rock, being part of the general ledge called Little Scotland, and projecting north of the said rock about 90 feet, where its termination is in a depth of 16 feet at low water spring tides.

I propose another pier, to commence on the little Dulce Rock, north of the head of the present pier, and to pass over the great Dulee Rock in a straight line, so that this part of the pier shall in like manner be about 430 feet in length, and having three kants extending beyond this, similar to the south pier; the extremity of the last kant being also in 16 feet water, and its head distant from the former about 150 feet. The two last kants of each pier are to be inclined to each other, by which the waves acting against them will be reflected in such a manner as to destroy each other's effect, and prevent any material run of sea into the harbour.

The distance between these two piers will be about 550 feet, and the new pier-heads will be about a like distance N.E. or to seaward of the present pier-head; so that in fact the entrance will extend to seaward beyond any of the present rocks, and of course vessels going out of the harbour will be in deep water upon leaving it.

I propose that all the rock lying within the south pier shall be excavated — that under the straight part of the pier to the depth of at least 12 feet under low water, and that within the short kants to 16 feet. The space between the little Dulee Rock and the shore shall be left open, so that, should any swell get into the mouth of the harbour, from gales of wind blowing from any of the points to which its mouth is exposed, it will have ample room to expand on the flat shore, south of the old pier; and as the currents will have a free passage through it, there will be no danger of sand settling within it so as to shoal the water, while the inclined kants of each pier will afford ample shelter for the packets against any gale to which the harbour can ever be exposed.

The expense of this harbour will however be great, amounting, as per estimate, to the sum of 140,633*l.*, exclusive of a lighthouse which will cost about 4500*l.* more, the same as that at Port Patrick.

The harbour I have described will not only be of sufficient magnitude for the accommodation of His Majesty's packets and the other vessels that belong to the port, but will also afford a safe and convenient station for the revenue cruizers, which may lie afloat, and be ready to proceed to sea whenever their services are required, which is not the case when they lie in Belfast Lough, as it often happens that when their services are most wanted they cannot get to sea in time to be useful.

I am, &c.,
JOHN RENNIE.

The Right Honourable the Postmasters-General of Ireland,
&c. &c. &c.

Estimate of the probable Expense of a Harbour at Port Patrick, upon a small scale, as delineated on the Plan No. 1.

	£.	s.	d.
To excavating 12,100 cubic yards of rock above and below low-water	6,159	0	0
To masonry of two piers and jetties, part above and part below low-water, 13,413 cubic yards	46,440	0	0
To filling the piers with rubble, and paving them	6,306	0	0
To rubble backing to ditto	11,053	0	0
To deepening harbour in sundry places	3,000	0	0
Contingencies	14,592	0	0
	£87,550	0	0

APPENDIX C.

PORTPATRICK.

No. 429.
Rennie, on the formation of the Harbour.

Estimate of the probable Expense of a Harbour at Port Patrick, on the larger scale, as delineated on the Plan No. 2.

	£.	*s.*	*d.*
To excavating 16,000 cubic yards of rock above and below low-water	8,791	0	0
To masonry in two piers and jetties, 19,150 cubic yards, above and below low-water	63,106	0	0
To filling the piers with rubble, and paving them	11,568	0	0
To rubble backing of piers	12,600	0	0
Contingencies	19,215	0	0
	£115,280	0	0

Estimate of the probable Expense of a Harbour at Donaghadee, according to the Plan.

	£.	*s.*	*d.*
To excavating 42,332 cubic yards of rock above and below low-water	23,250	0	0
To masonry in two piers and jetties, part above and part below low-water, 17,536 cubic yards	61,270	0	0
To filling the piers with rubble, and paving them	10,790	0	0
To rubble at back of piers	21,884	0	0
Contingencies	23,439	0	0
	£140,633	0	0

We, the undersigned commanders of His Majesty's packets on the station between Donaghadee and Port Patrick, and masters of several of the vessels plying between said ports, do hereby certify and attest, that we have duly considered the annexed sketches of plans for the improvement of the harbours of Donaghadee and Port Patrick, and we are decidedly of opinion that the same, if carried into execution, will fully answer the desired effects of facilitating and promoting the intercourse between the two ports, and of rendering the same at all times more safe, easy, frequent, and expeditious. We have heard it stated, that it has been suggested to open a passage at Port Patrick towards the north-west, instead of the proposed north-west pier. We are decidedly of opinion that the said passage would be perfectly useless, and might be dangerous, as the only winds that a packet would ever require to sail from Port Patrick by such a passage would be those from the southward and south-west, and with those winds a packet could sail from the proposed new south pier with more facility and safety. With south-west gales the sea is always much heavier at that place proposed for a north-westerly opening to Port Patrick than at any other place along the coasts, and we take leave to protest against any such opening to the north-west at Port Patrick. We most strongly recommend the adoption and execution of the plans as proposed by Mr. Rennie, of which we understand the annexed are sketches.

Given under our hands, at Donaghadee, this 26th April, 1819; and we can attest the truth of the same, if required.

(Signed) ALEXANDER MURRAY, Commander of H. M. Packet Downshire.
JAMES KENNEDY, Commander of H. M. Packet Westmorland.
HAMILTON CRANSTON, Commander of H. M. Packet Hillsborough.
JAMES M'CONNELL, Commander of H. M. Packet Pakuer.
WILLIAM AGNEW, Master of the Mary Anne.
DAVID SHANKS, Master of the Clupea.
HENRY RAINEY, Master of the Dunvegan Castle.
JAMES PIERCY, Master of the Earl of Stair.
ROBERT M'TIER, Master of the John and Samuel.
WILLIAM THORBORN, Master of the Lady Isle.
JAMES GILLESPIE, Master of the Friendship.
RICHARD CARMICHAEL, Master of the Belle Anne.
WILLIAM BURNS, Master of the Bachelor.
HUGH ALEXANDER, Master of the Vanguard.
ROBERT BOYLE, Master of the Speculation.
HUGH MARTIN, Master of the Intrepid.

No. 430.

Selections from the Report of Captain F. W. BEECHEY, R.N., F.R.S., *on the Packet Stations, and Communication between the South of Scotland and North of Ireland.*

Her Majesty's Surveying Steam-vessel African, at Sea,
October 1, 1837.

No. 430.
Beechey, on the Packet Stations, and Communication between the South of Scotland and North of Ireland.

SIR,

IN compliance with their Lordships' direction, I have carefully examined the harbours of Portpatrick, Donaghadee, Cairn Ryan, Larne, Stranraer, Belfast, Girvan, and Greenock, with regard to their eligibility for mail packet stations between Scotland and the North of Ireland.

I have obtained all the information I could at each place from persons whom I found competent to throw any light upon the subject of inquiry; and I have attended meetings of the inhabitants and of the Chambers of Commerce of Belfast and Greenock, and have received from them various memorials and other documents which they were so good as to draw up for my guidance, to all of which I have given my best consideration.

In advance, Sir, you will find my reports in detail upon the various places I have visited, with copies of the documents above alluded to; together with sketches of such of the ports as were necessary, and remarks which appeared to me calculated to put their Lordships in full possession of every particular.

The general principle impressed upon me by their Lordships, "that the shorter the sea passage the more precise will be the regularity and certainty of the arrival and despatch of the mails," led me

APPENDIX C.

PORTPATRICK.

No. 430.
Beechey, on the Packet Stations, and Communication between the South of Scotland and the North of Ireland.

to inquire, first, into the merits of Portpatrick and Donaghadee; these two places comprising the shortest distance between Scotland and Ireland, with the exception of the coasts of Cantire and northern part of the Antrim, which are wholly out of the question.

After a careful examination of the capabilities of Portpatrick, and an inquiry into the opinions of the officers stationed there, as well as of those who have for several years been in command of the packets, I have no hesitation in saying that that port is not, nor ever can be made, a safe harbour, either to run for or depart from in tempestuous weather from the westward, without incurring an enormous expense.

The disadvantages of Portpatrick are stated in detail in the subjoined observations, I shall merely mention here, that it is too exposed, too shallow, and too contracted event for the boats at present employed there. They cannot quit it or enter it with a westerly gale, without the imminent risk of life; they cannot go out at low water, and in entering with a following gale are compelled to run aground; and the channel is so narrow that check ropes are necessary to prevent their running their bowsprits against the cliff.

These defects I consider quite sufficient to condemn the port; but they will be still more felt should their Lordships think proper to put upon this station boats of a sufficient length and power to command the passage. There can be no doubt that many of the failures of the delivery of the mail on this station have been owing to the want of power of the packets; I do not mean of the engines alone, but of the boats themselves; they require to be of greater length, and altogether more powerful vessels, to contend with the heavy breaking seas which occur in the channel they have to navigate.

To Donaghadee there is no insuperable objection; although small, affording bad shelter with easterly winds, and hazardous to enter with easterly gales, yet it must be recollected that its protection is required for an hour only each day: it has to be attempted during daylight always, and it is situated on the weather shore as regards the prevailing wind. Besides, a moderate outlay would materially improve this port. The objection to the present route of the packets, therefore, Sir, rests with Portpatrick; and I confess it appears to me to be irremediable.

I have, &c.,

Charles Wood, Esq., Secretary, &c., Admiralty. F. W. BEECHEY, *Captain.*

Observations upon the Harbour of Portpatrick.

PORTPATRICK consists of an outer and inner harbour, the dimensions of which (both included) are about 710 feet by 495 feet. They are formed between two piers, of which about 140 feet of the northern one and its jetty are incomplete. A rock called M'Cook's Craig, nearly separates these two harbours, leaving a narrow circuitous passage of 105 feet in width. The outer harbour has from 20 feet to 4 feet water at low-water spring tides, and the general depth of the inner harbour is $6\frac{1}{2}$ feet, but between these two there is a bank which has only $2\frac{1}{2}$ feet water upon it at low-water springs.

The plan which I have the honour to transmit will at once explain to their Lordships the nature of the port, and exhibit the serious objections which I consider to apply to it as a station for the packets between Scotland and Ireland.

It will be observed, first, that it lies open to the prevailing winds, which blow at least eight months out of the year; they are frequently very violent, and always occasion a heavy sea, which rolls into the harbour of Portpatrick with such force, that no vessel can lie in the outer harbour with safety, nor in the inner without sustaining injury to her sides and fastenings, and occasionally a derangement of the engines.

2nd. There is a bank with only $2\frac{1}{2}$ feet water upon it at low-water spring tides, within 440 feet (three lengths of the packets) of the jetty heads; so that a vessel running in before a gale has not room either to round to or bring up, and she is compelled to run aground, which has hitherto been the practice of the packets.

3rd. There is not space for such classed vessels as are required in this sea in order to command a precise and expeditious delivery of the mails, to round M'Cook's Craig conveniently in order to enter the inner harbour, even supposing the obstruction of the shoal to be cleared away.

4th. If during any of the prevalent gales upon the coast, an accident were to occur to the machinery of the engine, either while running in or attempting to get out, or if a vessel were to fail in the attempt after she had cleared the jetties, she must either be thrown upon the piers or driven into one of the bays on either side of them, and inevitably lost; or if she were fortunately forced back into the harbour, she could hardly fail of being driven upon M'Cook's Craig and stranded.

5th. Owing to the shallowness of the harbour, it is necessary to detain the packets about an hour and a half after the proper time of starting, for three days about the full and change of the moon; a detention which must destroy the regularity so desirable in the delivery of the mail.

In short, their Lordships cannot fail to observe that it is a dangerous harbour to enter or depart from in tempestuous weather; that it is too shallow, too much exposed, and in every way too small for the purpose.

If it should be alleged that for eleven years the packets have used the port daily, and with few exceptions entered it with all winds and in all weathers with only one casualty, the answer is, that it has been done at the imminent peril of life and vessel whenever it has been attempted during a westerly gale, and it has been accomplished only by commanders of great nerve and skill, and who are intimately acquainted with the intricacies of the port; and even these officers, on several occasions, have been either wholly deterred from carrying the mail across, or, having sailed with it, have borne away for other ports, from a conviction of the hopelessness of attempting Portpatrick at such a time. Besides, Sir, after all, it appeared that in defiance of the great zeal and intrepidity of the commanders of these packets, there has been a greater irregularity in the delivery of the mails on the Portpatrick station than on any other, and it is to be observed, that this has occurred upon a station where the distance to be traversed is less than on any other.

With regard to any improvement that could be made to the port, so as to render it a fit station for the packets, I beg to state, that after a very careful examination and much inquiry upon the spot, I am of opinion that any attempt of that nature would be attended with an expense which would outweigh the advantages to be derived from it.

APPENDIX C.

PORTPATRICK.

No. 430.
Beechey, on the Packet Stations, and Communication between the South of Scotland and the North of Ireland.

In the first place, I conceive it will be necessary to protect the harbour by a breakwater, without which no vessel will be able to lie in the outer harbour, or take it in a gale, without the risk of running aground; and in the next place, to deepen the port to 10 feet at low-water spring tides.

A breakwater, to be of service, will have to be based in from 6 to 8 fathoms water at low water, and must be of the most solid and substantial construction; and to give 10 feet water all over the port, there will require to be removed, at a rough estimate, about 20,000 cubic yards of earth, consisting principally of clay and rock, of which by far the greater portion must be performed by a diving-bell.

The enormous expense which would attend these operations sufficiently justifies me in recommending the abandonment of Portpatrick; especially, as I shall be able to show their Lordships that there are other ports better situated with regard to the mail deliveries, not far from it, and which may be entered with all winds and in all weathers, and with a moderate outlay may be adapted to the purpose.

I may perhaps be allowed to mention also, that I am of opinion that the difficulty of entering the port will be considerably increased when the northern jetty will be finished, and I do not think it will greatly tranquilise the harbour. With a north-west wind it will be of no use, as a line drawn from the pier-head to the south-east passes clear of it; and with a south-west wind it is hardly required, as the sea had better be allowed to expend itself upon the northern pier and at the back of M'Cook's Craig, than suffer a check, which will occasion such an agitation in the entrance, as will perplex the most skilful helmsman in a dark stormy night. With the wind between these points, at west for instance, it will cant the sea over upon the southern side of the harbour, in the very place where the packets ought to be in readiness for a start.

If the northern pier is to be carried farther out, I take the liberty of suggesting its extension in the manner exhibited in my plan upon the slip of paper, which, when turned down, blinds the present pier end.

I may mention also, that the inner harbour would be more quiet without the old pier, which is so placed, as to turn the swell which enters the outer harbour into it. If this pier were removed, the swell would take a nearly opposite direction, and expand itself upon the beach of the old harbour. But the removal of this, I must admit, would be a great inconvenience to the small vessels trading with the port.

In the correspondence annexed, you will find that Commander Little is of opinion that a long experience at Portpatrick materially diminishes the apparent dangers and difficulties of the port, and that he is now more disposed to think well of it than at the time when his evidence was given to Commander Evans, R.N. In Nos. 4 and 5, also, you will find the statement made by the carpenter and engineers on the same occasion somewhat qualified; while in Nos. 2 and 3, it appears that a long experience of the commanders of the packets confirms them in their opinion of the dangerous and difficult nature of the port.

In No. 6, Mr. Napier is of opinion, "that a steam-vessel of 150 tons, and 75 horse power, drawing 6 feet 3 inches water, could be built to answer the passage."

No. 7 contains an opinion of Captain L. Smithett, as to a saving in time which might have been made by increasing the power of the engines of the packets.

No. 8, from Commander Little, shows that a small increase of the power of packets gave more confidence to the commanders, and occasioned greater regularity in the delivery of the mails, and that this regularity would have been still greater had there been a third packet on the station. It also states, that the packets at Portpatrick have communicated with Ireland and returned in six hours, when steamers of greater power would have had much difficulty in getting out of Loch Ryan, and on one occasion actually failed. Captain Little is of opinion, that if Her Majesty's Government should be pleased to put upon the Portpatrick station three vessels, of 130 tons each, and 60 horse power, and drawing 7 feet water, the packet duties would be performed equal to, if not better than, any other station.

No. 17 contains replies of Mr. Wallace, mate of the Fury packet, to questions put to him by Captain Beechy, in which he mentions the grounding of the packets in entering with south-west gales; that a vessel of more than six feet greater length of keel than the Fury could not round the M'Cook's Craig. He thinks it would not be safe to approach Portpatrick after dark in thick weather and with a south-west gale; and states that there are three mornings, about full and change of the moon, when it is necessary to detain the packets from one hour to two hours, on account of the shallowness of the harbour. He also speaks of the badness of the light at Portpatrick; states the length of the passages between Portpatrick and Donaghadee, the safety of entering Donaghadee, and other matters connected with the stations.

No. 431.

Sir J. RENNIE, F.R.S., *on the effects of the Gale of the 5th January*, 1839, *on the Works at Portpatrick.*

No. 431.
Rennie, on the effects of the Gale of the 5th January, 1839, on the Works at Portpatrick.

London, April 6, 1839.

MY LORDS AND GENTLEMEN,

I BEG to acknowledge Mr. M'Neel's letter of the 14th January last, accompanied by a report from Mr. Linn, of the 9th, stating that on the evening of the 6th a severe gale commenced with the wind S.S.W., and continued increasing all night until the morning of the 7th, when the wind, veering to W.S.W., and lastly W.N.W., it amounted to a perfect hurricane, such as had never been witnessed within the memory of the oldest inhabitant, or mentioned upon record. The sea raged with irresistible violence, and threatened to bear down all before it. About daybreak of the morning of the 7th, it was discovered that the sea had made a breach through a portion of the front wall of the south pier-head, and had washed out a portion of the rubble between the light-house and the back of the outer wall; the height of the hurricane lasted about twelve hours; but as the storm continued to rage violently during the whole of the 7th and part of the 8th, it was impossible to approach the south pier-head until the 9th, and ascertain the extent of the damage done, when it was discovered that the front wall where the circular and straight part of the head unite had been breached to the extent of 35 feet wide, extending to about 6 feet below low water. The wall was built in the most substantial manner,

APPENDIX C.

PORTPATRICK.

No. 431.
Rennie, on effects of the Gale of the 5th January, 1839, on the Works of Portpatrick.

and was solid, nearly 13 feet thick, and well dowelled and dovetailed, and tied together with wrought iron as strongly as possible, and well backed by heavy rubble, a considerable portion of which was also washed out from between the back of the outer wall and the foundation of the light-house, and 22 feet of the coping of the outer angle of the jetty was also removed, as well as a small part of the pavement of the pier near it; the glacis at the back of the south pier-head was also partially ripped up. On the north pier no damage was done. The damage, as above described, is no doubt severe, and can, when the extraordinary and unprecedented violence and continuance of the hurricane are considered, well be accounted for, its disastrous effects not being confined to Portpatrick alone, but even falling with equal if not greater severity throughout the whole of its devastating course, comprising as it were a belt of 150 miles wide, stretching on a W. by N. and E.S.E. direction through Ireland, Scotland, and England, with a violence hitherto known only in the tropics, unroofing houses, tearing up trees by the roots, and strewing the shores of the Mersey with wrecks to the extent of a million and upwards, accompanied with a great loss of human life, in fact, leaving nothing but ruin and desolation in its path. Under such circumstances it was not to be expected that Portpatrick, lying as it were in the centre of its track, and exposed to its utmost violence, should have escaped unhurt, although it may be satisfactory to know that but for the outer harbour, in all probability the whole town, together with Her Majesty's packets, would have been swept away. As it was, however, so complete was the protection afforded by the new harbour, that, with the exception of the damage to the south pier above mentioned, nothing occurred within, save that the "Asp," one of the packets, was slightly injured by rubbing against the rock, but the brig "Amity," from Ayr, found safety by taking the harbour during the height of the hurricane; whereas at the Troon, which is by no means so much exposed on the same line of coast, twenty-five vessels of different sizes were stranded *within the harbour*, and the adjacent coast strewed with wrecks; and *even in Loch Ryan*, which is almost *land-locked*, the "Mary" packet sunk at her moorings; two or three vessels went on shore at *Cairn Ryan*; one of Her Majesty's cutters was obliged to cut away her mast to prevent her from going ashore, and the schooner "Ann" was completely wrecked. One of the steamers was driven ashore on the Scaur; the other was *absolutely driven* from her moorings lying *alongside the quay* at Stranraer, and was cast ashore near North-West House, where she lay for for a fortnight much damaged, and was obliged to be taken into dock and repaired at a considerable expense. With regard to the extent of the damage done to the south pier-head, it must be considered in two ways; first, the absolute cost of repairing it as it was before the storm, which cannot be estimated above 3,900*l.* and in this state it had resisted the most severe gales ever known to the present time, without the smallest signs of yielding ever since its completion, eight years since; and if it should only have to encounter for the future the usual storms of this coast, it would not be necessary to take any greater precautions now than before, which had been carried as far as the original design and estimate warranted, so that the absolute loss to the public cannot be stated at more than the sum of 3,900*l.*, above mentioned, which is very small considering the unusual circumstances of the case, and still more so when compared with the unprecented losses sustained in other places, where less might have been expected. But what has occurred once may occur again; it would not therefore be prudent only to reinstate the work as it was previously to the extraordinary hurricane of the 6th and 7th January last, but to restore the work with such additional precautions that it may be enabled to resist successfully not only similar, but even *if possible*, more severe hurricanes than that of the 6th and 7th January last, which would be effected by making the pier-head of solid masonry, similar to that which has been adopted on the north pier. I therefore am of opinion that the estimate of Mr. Linn, amounting to 13,600*l.*, for the completion of the work, should be adhered to, although I feel confident that it is ample, and the work may perhaps be completed for less. It should be considered that, although eight years have elapsed since the completion of the pier, no sum has been granted for occasional repairs and maintenance, which is usually allowed in all similar works, and might particularly have been expected here, so that the sum now demanded cannot be considered large when distributed over such a length of time. I beg leave to apologise that I have not been able to send this report earlier, but the stormy weather which has occurred, with little variation, ever since the 7th of January, has prevented me until now from ascertaining exactly the state of the south pier, although I have twice visited Portpatrick with that object. I beg leave to add, that it is absolutely necessary that an early decision should be made as to future operations, because the season is now arrived when stone should be ordered and other preparations should be made for completing the work, which, if deferred, may be attended with much extra delay and expense, because, if not completed during the ensuing summer, it is difficult to foresee what may be the consequences if left exposed in its present state during another winter; but if taken in hand immediately, there can be no doubt of making it more perfect than ever; and notwithstanding what has occurred, I feel perfectly convinced that few works of this difficult nature have been executed more closely to the original estimate, and that the more the merits of this station are investigated, the more it will be found that, under all the circumstances, it is best adapted for keeping up a regular, safe, and economical communication between Scotland and the north of Ireland.

I am, &c.,
JOHN RENNIE.

Extract from Treasury Minute, dated May 28, 1839.

MY Lords will submit to Parliament a grant of 3,900*l.*, being the amount estimated by Sir John Rennie for placing the harbour in the same efficient state as before the storm in January last; but their lordships do not consider it expedient to complete the pier in the manner proposed, which would occasion an expediture of 13,600*l.*

No. 432.

Letter from Sir John Rennie to Sir John Barrow, Bart.

No. 432.
Rennie, on the Eligibility of the Harbour as a Packet Station.

SIR, *London, April* 25, 1842.

I BEG leave to acknowledge the receipt of your letter of the 14th ultimo, accompanied by the Report of Captain Beechey, of the 1st of October 1837, and the several other documents, relative to the most eligible ports for the mail-packets, for the purpose of carrying on the communication

APPENDIX C.

PORTPATRICK.

No. 432.
Rennie, on the Eligibility of the Harbour as a Packet Station.

between the south-west part of Scotland and the north of Ireland, upon which you inform me that the Lords Commissioners of the Admiralty desire to have my opinion. The subject is one of great importance, and has occupied the attention and serious consideration of some of the ablest nautical as well as civil engineering authorities for upwards of half a century, and many and various have been the opinions given upon it. The question, however, divested of all extraneous matter, may simply be divided into two parts.

1st. What, under all the circumstances, are the best stations on each side of the channel, comprehended within a reasonable distance, for carrying on the communication between the south of Scotland and the north of Ireland.

2nd. What accommodation is required at the ports selected, in order to enable the communication to be carried on in the most regular, efficient, and economical manner.

With regard to the first:—Commencing with the present stations of Portpatrick and Donaghadee, it appears that they were selected by the public for the purpose of carrying on the communication between the south of Scotland and the north of Ireland, from the earliest records; and about the year 1770, a small pier was constructed at Portpatrick on the east side of the bay, by Smeaton, previous to which the place was in a state of nature. Smeaton says, "The harbour of Portpatrick is at present entirely in a state of nature, a small platform for the more commodious landing and shipping of passengers, &c., excepted; and indeed it has many natural advantages, being very easy of access, and of sufficient depth to ride the vessels proper to be employed afloat at low water, and to protect them from storms coming from seven-eights of the whole compass, and had the remaining eighth been as well guarded as the rest, the harbour had been complete." Another pier was constructed on the south side of Donaghadee Bay, it is supposed about the same time. Both of these stations were what is termed tide harbours. In this state they remained until about the year 1800, when complaints having been made as to their inefficiency, the subject was taken up in a comprehensive manner by Parliament in the year 1802; nothing however was done until the year 1808, when the late Mr. Telford and Captain M'Kerlie, of the navy, were appointed by the Government to survey both sides of the channel and investigate the subject fully, in order to ascertain whether the stations of Portpatrick and Donaghadee were, under all the circumstances, the best adapted for carrying on the communication; and if so, whether any, or what improvements could be made in them to render them more efficient or whether any other and what places could be selected, offering more advantages as packet stations, and the improvements that would be necessary to render them efficient.

These gentlemen, after making a very detailed and elaborate survey of the whole coast on both sides of the channel, finally made their report in 1809, and recommended that Donaghadee and Portpatrick should be abandoned, and that new harbours should be constructed at the bay of Port Nessock on the Scotch side, eleven miles to the eastward of Portpatrick and Bangor Bay on the Irish side, about seven miles to the westward of Donaghadee, nearer to the entrance of the Lough of Belfast. The propriety of this decision being much questioned, and not giving satisfaction, the whole question was opened again. The late Mr. Rennie in the year 1814, was appointed by the Postmaster-General to survey both sides of the channel between the Mull of Galloway and Corsewall Point on the Scotch side, and Burr Isle and the Lough of Belfast on the Irish side.

Accordingly, in the year 1815 Mr. Rennie prepared charts and obtained the necessary local information connected with every place where any probability existed of making a harbour, including Portpatrick, Ardwell, and Port Nessock Bay, on the Scotch side, and Bangor, Ballyholme, Port Avo, and Donaghadee, on the Irish side, and transmitted the documents to the Lords of the Treasury, who after paying due attention to the various conflicting opinions and interests concerned, finally, at the recommendation of the late Mr. Rennie, referred the whole question, not only including the documents proposed by the late Mr. Rennie, but also those of Mr. Telford and Captain M'Kerlie, and of every other person at all conversant with the subject, to the Trinity Board, as the most impartial and competent nautical authority to decide the question. This was accordingly done, and the Trinity Board, after having thoroughly investigated all the documents transmitted to them, and having obtained such other information as appeared to them necessary; finally, on the 9th February, 1818, recommended that Portpatrick should be adopted as the most eligible station on the Scotch side; and after having called for further surveys relative to the Irish side, on the 6th October, 1819, gave it as their decision that Donaghadee should be adopted on the Irish side, and that the harbours of these two places should be converted into low-water harbours, and improved as far as practicable, to render them complete for the purpose of carrying on the communication between this part of Scotland and Ireland in the most efficient manner possible. The Lords of the Treasury adopted the recommendation of the Trinity Board, and directed the late Mr. Rennie to prepare plans accordingly for the improvement of Portpatrick and Donaghadee harbours, which he did in the year 1820, and separate Acts of Parliament were passed authorising the Treasury to grant the necessary funds for carrying them into effect, and increasing the rates of postage on all letters between that part of the two countries, to enable them to defray the expense. The harbours accordingly were commenced in 1821; that of Donaghadee was completed in 1836, according to the accompanying plan, and that of Portpatrick has been carried on up to the present time, when the south pier is nearly completed, and the north pier, with the exception of the jetty and pier-head, although steam-boats to carry the mails were established about the year 1826. In the year 1823, before any considerable progress had been made in either of the harbours, a Committee of the House of Lords was appointed to investigate the different circumstances as regarded the eligibility of Portpatrick and Donaghadee as the stations for the packets. In the course of the discussion, various other places were brought forward as being superior, but nothing occurred to invalidate the conclusion of the Trinity Board, and the Committee after hearing all the evidence, decided, I understand, that Donaghadee and Portpatrick were the proper stations, and the work proceeded without interruption until the year 1830, when the subject was renewed, and a Committee of investigation was appointed by the House of Commons, which, after having again heard all the evidence adduced in favour of Glasgow, Greenock, Adrossan, and the Troon, Loch Ryan and Belfast, and against Donaghadee as Portpatrick, again decided that it was not advisable to alter them. In the year 1834 a commission was appointed by the Government to examine all the Post-office packet stations, and amongst others that of Donaghadee and Portpatrick, when it does not appear that any alteration was decided upon; still, however, the subject was again revived in 1836, and the report of Captain Beechey has been the result; and here it may be naturally asked, after such repeated investigations and discussions during a period of above thirty years, what were the reasons which induced the authorities of 1770, the Trinity Board in 1820, and

APPENDIX C.

PORTPATRICK.

No. 432.
Rennie, on the Eligibility of the Harbour as a Packet Station.

the Committee of the House of Lords in 1823, and that of the House of Commons in 1830, to decide in favour of Portpatrick and Donaghadee, as being the best stations, under all the circumstances, to carry on the communication between the south-west of Scotland and Ireland; these I understand were—

1st. The distance, which is only 21¼ miles, being the shortest possible between the two countries, with the exception of that between the Mull of Cantire and the opposite coast of Antrim, and which is so much out of the way that it is entirely out of the question: this is, without doubt, a most important point, particularly during the winter season, when storms from southerly and westerly points are very prevalent, and render the Scotch side of the channel a lee shore; under such circumstances every additional mile of distance, either to a sailing or steam-vessel contending against a heavy gale, is of serious consequence. The risk of accident, which in long voyages is greatly increased, between Portpatrick and Donaghadee is reduced to comparatively nothing; and although a well-constructed and powerful steam-vessel can do a great deal, nevertheless she is liable to an accident, which, if such should take place, the passage may be prevented or materially retarded, which invariably happens during stormy weather, for even with the powerful steamers of the Liverpool and Holyhead stations the passage is increased from 10 to 20 hours in the former, and 6 to 12 in the latter; moreover, a lull of one or two hours frequently occurs during the most severe storms, when a short passage of 21 miles would be effected, which in a longer one would never be attempted.

2nd. From the prevalence of winds from the westerly and southerly points for nine or ten months out of the year, the short passage possesses most material advantages, for it must frequently be made striving against a heavy south-westerly gale and head-sea; but after the first half of the passage is made, the fetch of the sea is diminished, and the water becomes comparatively smooth, whereas in a longer passage this advantage could not be had.

3rd. The sets of the tides form an important feature in this passage; at Portpatrick spring tides rise 13 feet 3 inches, neaps from 7 feet to 7 feet 6 inches; it is high water at the full and change of the moon at 11 A.M., but the highest tides flow until three-quarters past 12; the time of the flood and ebb are nearly the same, but upon the whole the duration of the flood is rather less than that of the ebb, and the flood current is therefore the strongest; it makes along the shore about an hour and a half before low water, and runs to the southward within two hours before high water; it then turns to the northward, and continues in that direction until within an hour and a half of low water. The flood current in the channel makes to the south-east about an hour before low water, and continues in that direction until within about an hour of high water; the separation of the inshore and channel tides is distant about a quarter of a mile from the shore, and at springs runs at the rate of about three miles per hour, and at times more; supposing, therefore, a packet to start from Portpatrick two hours before low water, during the springs, with a heavy gale from the south-west, which is the most unfavourable time, she would have the current setting in a contrary direction to the wind, and thus prevent her going to leeward, and make her passage without difficulty before the flood current could affect her. Again, if she happened to start from Portpatrick during neaps, the wind being the same way, the current would be so trifling as to have very little effect. Donaghadee lies west and by south from Portpatrick; springs flow 12 feet, neaps 7: it is high water at the full, and change at 11, but the best tides flow about 12 o'clock. The flood current makes to the south, along shore about two hours before low water, and continues in that direction until low water: it then turns to the northward, and continues in that direction until within two hours of low water, so that there are only two hours of south current and ten hours of north current; so that if a packet sailing from Portpatrick should be carried by the flood current to the southward, as she approaches Donaghadee she finds it in her favour. In the channels between the Copeland Islands the current was five hours and a half to the south, and six hours and a half to the north; outside of the islands there is an east or off-going current, which sets south until within one hour and a half of low water, then south-east by south to within one hour and a half of high water; it then changes its course north for four hours and a half, or to three hours after high water; the channel tide then makes on it and changes it to west-north-west until within one hour of low water; so that this off-going or east current has nearly six hours' flood, and rather more ebb. As the packet always starts from 5 to 6 A.M. from Portpatrick, if she had power enough these currents would either be turned to her assistance in making the passage, or else create little or no impediment. It is almost unnecessary to make any remarks upon the passage from Donaghadee to Portpatrick, because as the wind is generally favourable from that quarter, there is no difficulty except during easterly storms, where after steaming a few miles against the wind, she soon gets under protection of the high land on the Scotch side, with a smooth sea, and effects her passage with very little delay.

4th. The coast on either side is clear of rocks and shoals, the land is bold, the water deep, and is easily made for in foggy weather; so that, whether as regards distance, winds, tides, absence of shoals, all of which are most important, the advantage is in favour of Donaghadee and Portpatrick. I now come to the harbours; Portpatrick, when completed, will consist of two piers; that on the south side is 620 feet long from the shore, with a jetty 80 feet long at 120 feet from the extremity; the north pier will be 650 feet long, with a corresponding jetty of the same dimensions, leaving a clear opening between them of 180 feet for an entrance pointing south-west by south by compass; the depth at the entrance varies from 17 to 20 feet at low water of spring tides, and decreases to 6 and 7 feet at the inner harbour, but less at the entrance to it. The south pier and jetty may be said to be nearly finished, and the north pier also, with the exception of the jetty (for it is not necessary to finish the head) and the removal of some of the rocks and part of the old pier, enlarging and deepening the entrance to the interior of the harbour. The harbour, therefore, in its present state, cannot afford that protection either when the packets are in, or that facility of ingress and egress which it would do if completed. The packets, moreover, are greatly deficient in power for their size, having only engines of the united power of 50 horses, and ill adapted for the passage. Notwithstanding, however, these temporary defects, it is a notorious fact that the mails have been carried upon this station with a degree of regularity very little surpassed by any other stations possessing superior advantages.

It appears from the journal of Mr. Linn, the resident engineer, that during last year there was only one day, viz., the 3rd of January, 1841, that the packet did not sail from Portpatrick; and from the 26th January last year to the present time, there have been only two mails that did not arrive at Donaghadee; but in consequence of the mail arriving at Donaghadee from Belfast frequently from two hours and a half to four hours and a half behind the time, the packet cannot arrive at Portpatrick in time for the Glasgow mail, so that they are sometimes obliged to be forwarded by express to Glasgow; this, however, is not the fault of Portpatrick; such is the state of the communication, even with the

APPENDIX C.

PORTPATRICK.

No. 432.
Rennie, on the Eligibility of the Harbour as a Packet Station.

present unfinished state of Portpatrick harbour, and the very inefficient packets belonging to the station. If, however, the harbour be completed, and the interior enlarged and deepened, and some of the rocks removed, together with part of the old pier, so that there may be always 7 feet at low water of spring tides at the entrance to the inner harbour, packets of about 100 or 110 feet long, and about 20 or 22 feet beam, with a draught of from 6 feet to 6 feet 8 inches, and engines of 100 to 110 horse power, (the present packets drawing 6 feet 10 inches, with only 50 horse power,) there would be ample room for the packets either to bring up in or to get sufficient way upon them on starting, and the passage would seldom, if ever, exceed three or four hours, and generally from one and a half to two hours; and if the mail from Carlisle were made to travel at the same speed as upon any other road, (whereas at present it seldom exceeds eight miles per hour,) it would arrive at Portpatrick at 5 (or earlier if the new Galloway road be adopted) instead of 7 in the morning, and thus generally reach Donaghadee by 7 or 9 in stormy weather, and Belfast by half-past 8 or 11 in the morning during stormy weather; and then start from Belfast at 2, reach Donaghadee at half-past 3, and then Portpatrick at half-past 5, and always in time for the Glasgow and Carlisle mails; and thus letters might be answered by the same post, and a day saved. In fact, from some cause or other, this station has been neglected; but by completing the harbour of Portpatrick, and having proper packets, it would be one of the most efficient in the kingdom for the purpose. Donaghadee consists of two piers; the south one attached to the shore 900 feet long, and the north or breakwater pier 820 feet long, with an outer entrance 150 feet wide, and the inner 575 feet; the entrance points north-east by north; the depth at the entrance is 15 feet 6 inches, diminishing to 8 feet at low-water spring tides, near the old pier foundations. Captain Beechey makes no remark about Donaghadee, except that it is too small, and there is a little swell during easterly winds; this, however, is so trifling, as to be scarcely deserving of notice, and no serious inconvenience has ever arisen to their packets from it, either whilst entering, departing, or lying there. Indeed, to make larger harbours or packets than those above mentioned would be perfectly unnecessary, and would only be a useless expenditure of public money; because, in any case, the great mass of passengers would generally go from Greenock to Ardrossan direct to Belfast; and after all, if incurred, the mails would not be carried more regularly or more quickly, but very probably less so, and at a much greater expense. Having thus, I hope satisfactorily, discussed the question as far as the present stations are concerned, I will now proceed to examine the stations of Loch Ryan and Larne, as proposed by Captain Beechey to be substituted for them.

1st. As regards the distance. This, according to Captain Beechey, is 34 miles, or nearly 13 miles more than between Portpatrick and Donaghadee; and as Corsewall Point is to the eastward of Lough Larne, and the prevailing winds are westerly, the bearings of Larne and Corsewall are the same nearly as between Donaghadee and Portpatrick, and the reach of sea greater. The passage must be made under far greater disadvantages, and instead of being performed, as between Donaghadee and Portpatrick, in from three to four hours during stormy weather, it would occupy from five to six hours, according to Captain Beechey. Again, a shoal, called the Hunter's Rock, lies in front of Loch Larne, and the Maiden's Reef a little to the northward, which in foggy weather and strong ebb tide are very dangerous and difficult to avoid. It is seen that the distance from Glasgow to Cairn Ryan is about 15 miles less than to Portpatrick; nevertheless, the distance from Dumfries to Cairn Ryan is nearly the same, even by Stranraer, but shorter to Portpatrick from Glenluce; but as the packets could not start until both mails had arrived, there would be no saving in this respect: in fact, at present the Glasgow mails arrive at Portpatrick about two hours before the Dumfries mail, and were this latter to be accelerated, which might only be done as before mentioned, the mail might reach Belfast, even with the present inefficient packets, from one to two hours earlier than at present. In order to encounter and complete within the time this extra length of sea passage, Captain Beechey proposes to employ vessels of the same power and tonnage as those between Liverpool and Kingstown; these are, I understand, worked by engines of 300 horse power. The first cost of these packets would be from 25,000*l.* to 30,000*l.* each, besides the wear and tear, expense of establishment, extra consumption of fuel, and extra men, which could not well be taken, according to the returns lately presented to Parliament of the cost of the different stations, at less than 5,724*l.* for each, or 11,448*l.* for both, besides the expense of two new harbours, which, according to the plans proposed would probably cost from 150,000*l.* to 200,000*l.*; this taken at 5 per cent. would be 8,750*l.* per annum, besides the two packets at 5 per cent., or 3,000*l.* per annum, and the expense of working at 11,448*l.*; so that the total cost of this station would be 23,198*l.* per annum: whereas that at Portpatrick (including 24,274*l.* to complete the harbour, 7,865*l.* to deepen and enlarge the interior, making a total of 32,139*l.*) at 5 per cent, or 1,607*l.* per annum, and 18,000*l.* to 20,000*l.* for two new packets at 5 per cent., or 1,000*l.* per annum, 6,462*l.* for working, wear, tear, coal, establishment ashore and afloat, making a total of 8,062*l.* per annum, or 15,136*l.* less than the Loch Ryan station, being little more than one-third, whilst there would be an absolute loss of from one to two hours in the delivery of the mail at Belfast; because, supposing the mail to start from Cairn Ryan at 5 A.M., it could not, according to Captain Beechey's calculation, make Lough Larne before half-past 10 or 11 in stormy weather, (which is the time to calculate upon,) and being 21 miles from Belfast, it could not arrive there before 1 P.M.; whereas, by Portpatrick, it could start at 5 A.M., and reach Donaghadee at 8, or half-past 8 or 9, and Belfast at half-past 10 or 11, with a clear saving of 15,136*l.* per annum to the public. I say nothing about the capability of Loch Ryan and Larne as fine harbours, for they are well known and duly appreciated; but the question to be decided is, which, under all the circumstances, are best adapted to carry on a certain, regular, expeditious, and economical communication between this part of the two countries, and the advantages, whether as regards distance, prevailing winds, tides, &c., and expense. I am of opinion decidedly in favour of Portpatrick and Donaghadee. If it should be considered advisable to contract for carrying the mails between Portpatrick and Donaghadee, it would be done for considerably less than I have stated; indeed, an offer was made to the Treasury in 1840 to carry them for 4,500*l.* per annum, if the harbour of Portpatrick was completed, including powerful packets and every expense; but as there would be no adequate means for remuneration with such expensive packets as those which must be employed between Loch Ryan and Larne, I doubt much whether contractors would be found to undertake to carry the mail for much less than I have stated. It should, moreover, be observed, that during strong northerly winds a heavy sea sets into Loch Ryan, so much so, that the steamers plying between Stranraer and Glasgow do not venture to leave their moorings, whilst the present inefficient packets of less power make their passage between Portpatrick and Donaghadee without difficulty.

With regard to Captain Beechey's observations on the passage between Glasgow and Greenock, they

No. 432.
Rennie, on the Eligibility of the Harbour as a Packet Station.

are entitled to every attention, and he has put the question as regards this station in a very clear point of view. He states that as a mail packet must start at a certain hour every day, during bad weather, and the wind blowing a gale from the south, the tide against her nearly the whole way, which happens four days in a fortnight, the passage would not be accomplished under twenty or twenty-two hours; and as the mail could not leave Greenock before 5 P.M., consequently she would not reach Belfast before 1 or 3 P.M., which would be two hours later than at present, and, even at the average passage, before 8. It might also have been added, supposing the mail to start from Greenock, what is to become of all the intermediate district between Greenock and Portpatrick, and Stranraer and Dumfries, comprehending a line of country nearly 180 miles long, and the important towns of Ardrossan, Kilmarnock, Ayr, Girvan, Maybole, Stranraer, Glenluce, Newton Stewart, Cree Town, Gatehouse, Castle Douglas, all of which must be sacrificed or send their correspondence by the circuitous route to Greenock, at a considerable extra delay and cost? The same objections may be urged against Ardrossan, the Troon, Ayr, and the immediate places in a lesser degree or proportion to the distance.

Captain Beechey has confined the decision of the stations to Loch Ryan and Portpatrick; and, as regards these, with all due deference, I am clearly of opinion, that whether as regards distance saving of time in making the passage and delivering the mails to and from Belfast, economy of the packets, the establishment of the great annual saving of expense, amounting to 15,136*l*., as above stated, the advantages are decidedly in favour of Portpatrick and Donaghadee; and, as such, I would strongly recommend their Lordships to adhere to a station which has now been adopted above seventy years; and, notwithstanding the disadvantages it has laboured under of unfinished harbours and inefficient packets, has maintained the communication between Scotland and Ireland in this stormy part of the channel with a degree of regularity which is really surprising under the circumstances.

I have, &c.,
JOHN RENNIE.

Sir John Barrow, Bart.,
&c. &c.

No. 433.

Report by J. WALKER, Esq., Pres. Inst. C.E., F.R.S., *on repairing the Works of the Harbour, and proposed Improvement.*

No. 433.
Walker, on repairing the Works of the Harbour, and proposed Improvement.

SUMMARY.

June 12, 1843.

As to state.—That, excepting the gradual silting up, which is about two feet in eighteen years, the breach in the south wall, which has been partially and temporarily repaired, and a displacement (of no great magnitude) of some stones, the harbour is in the same state as when opened in 1825.

That the harbour has several advantages and disadvantages, which are enumerated; but that, on the whole, it is for the present the best point for communication to Ireland from Scotland and the north of England.

That the greatest evil is want of water upon the bar or shelf between the outer and inner harbour.

Recommendations.—To deepen the bar to 7 feet at low-water of spring tides, this being the draft of the present packets.

To repair thoroughly the breach in the south pier, which is dangerous.

To protect the present works and the inner harbour, by depositing at places, as stated, large rubble blocks from the adjoining quarry.

To do what is required for supporting the north pier.

The estimate of all the works recommended, is 10,000*l*.

Not, for reasons stated, to proceed with the north pier, the estimate for finishing which is 35,000*l*.

SIR, *Great George Street, June* 12, 1842.

YOUR instructions to me, dated the 2nd June, desired me to proceed to Portpatrick with the least possible delay, to inspect the works of the harbour there; and you informed me, verbally, that a proposed meeting with the First Lord of the Treasury, and some of the parties interested, made it desirable that my report should delivered in by the 12th. By leaving on the 3rd, and taking with me an active an intelligent assistant, Mr. Drane, I have been able to accomplish the object, although, perhaps, less perfectly than if more time had been given me.

In addition to the survey, for which the weather was favourable, I took the evidence of and every information given me by Commander Wynn, the Admiralty agent, Lieutenant Boyter, commanding the "Pike" packet, and of other officers and individuals, including Mr. M'Neel, the secretary, and Mr. Murdoch, clerk to the commissioners.

I have also perused and considered the various reports and evidence to which you referred me.

The first question to me respects *the present state* of the harbour.

To this, *as a question of comparison with any former time*, my reply is, that, with the exception of some decrease of depth arising from the gradual deposit of sand and mud, the general state of the harbour for the convenience of vessels is as good as it has ever been, and that, as respects the works, no change has taken place since 1841, when the breach in the south pier, caused by the hurricane of January 1839, was partially repaired.

A minute description of the *general state or capability* of the harbour, would involve all the points upon which individuals, much better qualified, from long and intimate knowledge of the harbour, than I can be supposed to be, have so widely differed; but it is my duty to state the prominent features as they present themselves to me.

The favourable points of view are,—

1st. That the sea passage from Portpatrick to Donaghadee is the shortest practicable, between Scotland and Ireland; the distance is only 21 miles.

2nd. That the currents of the tides, as explained in Sir John Rennie's able report, generally assist the crossing; so that on the average, not more than *one day per annum* is lost in making good the passage; the irregularity, as to the time of the mails, arising much more from the non-arrival of the land mails at the harbours, particularly at Donaghadee, than from the time of making the passage.

3rd. That the regular time of arrival of the Irish packets, when the ebb-tides are the lowest, being about three hours after high water, there is generally sufficient depth for the packet from Donaghadee to enter the inner harbour, unless in case of delay on the Irish side, or in making the passage.

4th. That the south-west, which are the prevailing winds, and to which the harbour is open, tend to

APPENDIX C.

PORTPATRICK.

No. 433.
Walker, on repairing the Works of the Harbour, and proposed Improvements.

prevent the tide ebbing out of the harbour; enabling the packets to enter at or near low-water during south-westerly gales, when the sea into the harbour is the heaviest.

5th. The freedom which the mail packets enjoy from the interference of other vessels, Portpatrick being used almost exclusively for the mail packets.

6th. The whole cost of the packet establishment between Portpatrick and Donaghadee, exclusive of the original cost of vessels, being only about 4000*l.* per annum.

The fact that the present packets, the "Asp" and the "Pike," have been several years (one of them *eleven* years) without receiving any serious damage, or even requiring expensive repair, may also be quoted as a strong proof of the general facilities of the harbour.

To this favourable enumeration may be opposed,—

1st. The very small size (half an acre*) of the cove, or inner harbour, which is the only place in which even the present small packets can be afloat, in any degree of safety from storms.

2nd. The outer harbour, or entrance, being open to the southerly and westerly winds, which are the heaviest and most prevalent.

3rd. The heavy "run," during south-west gales, even in the inner harbour, being such as to require the greatest care, and very strong head and stern moorings, to prevent the packets being driven up against the rocks.

4th. The inconvenience and danger, through want of water upon the bar, of having to draw out of the inner harbour into the outer harbour or entrance, some hours before the time for sailing; this happens for four or five days during the spring tides, at which period the hour of leaving (half-past 5 A.M.) is nearly at the low water. On one or two occasions when the packet was in this situation, the officer in command has been obliged to go to sea without mail or passengers, the violence of the weather preventing his remaining or communicating with the shore.

5th. The same cause, viz., the want of water upon the bar of the inner harbour, obliging the packets sometimes to remain in Donaghadee until the tide is supposed to have risen sufficiently high to allow of their entering Portpatrick, without the danger or inconvenience of grounding upon the bar.

6th. The great length of land passage to Portpatrick by coach, without any towns of importance, viz., from Ayr (in the Glasgow route) being 50 to 60 miles; and from Dumfries (the Carlise route) 84 miles; thus adding to the time and expense of the journey; and hence there being but few passengers; so that the expense chargeable to the Post-office department is increased.

What I have stated on either side is, I believe, generally correct; it is by viewing one or other side *only*, that favourable or unfavourable conclusions are drawn. I have not called in aid the high authorities of Smeaton in 1770, or of Rennie in 1819, because then the passage was made by sailing vessels, when the shortness of sea passage was of greater consequence than it now is; and because neither of them probably contemplated the vessels being always afloat, or of sailing or entering at all times of tide.

Your second inquiry is, "Whether, for the preservation of the existing works, it appears to me necessary that any, and what, expense should be immediately incurred; and in what manner the sum that may be required can be most advantageously laid out?"

For the preservation of the existing works, the principal thing required, is the completion of the repair of the breach of the south pier. In its present state it is by no means *secure*, the repair having been but *partial* and *temporary*, neither going with any degree of certainty to the bottom of the breach, nor carried *out* to the line of the regular front.

Another failure might be much more serious than the last, when the light tower was in the most imminent danger. The expense of this repair depends so much upon the depth to which it will have to be carried, and which cannot be ascertained without the removal of the fallen material, and the assistance of the diving machine, that it is impossible to estimate it correctly. The quantities I have taken from measurements show an expense of 3560*l.*, in which I conclude making good some part (extra of the breach) that is damaged, substituting a better material for such of the loose rubble filling in the head as can be easily got at, and an additional quantity of large rubble at the foot of the slope behind the pier; also replacing the lantern of the light tower that was taken down after the breach.

At the junction of the south pier with the jetty, I recommend a quantity of large stones being thrown in, to protect the angle from the violence of the seas. Mr. M'Neel, who knows how the work is done, and has witnessed the power of the storms, considers this a weak point; and I quite agree with him, that a breach there would be most serious. This will add 500*l.*, making good some defects in the *north pier*, and adding some bolts, and securing the top, may cost 500*l.*

Thus I think that 4000*l.* to 5000*l.* will (*barring* further breach or accident) preserve the existing works.

The great evil and inconvenience arise, however, from the want of water upon the bar, between the outer and the inner harbour.

To the question put by me to every one whom I examined, "What have you to complain of in the present state of the harbour?" the uniform and almost the only answer was, "*Want of water upon the bar.*" I have already stated that a consequence of this is, obliging the packets to go over the bar into the outer harbour some hours before the arrival of the mails, causing danger to the vessels, and inconvenience in shipping the mail bags and passengers; and that a similar inconvenience is experienced with the returning packets, which, during heavy south-west gales, are detained at Donaghadee, or, if they cross too soon in the tide, are obliged to ground upon the bar, with a heavy swell after them.

This want of depth arises partly from the bar never having been excavated sufficiently, partly from a gradual accumulation of about 2 feet during the eighteen years the inner harbour has been formed, and partly from a dam or stank made for keeping the water out of the inner harbour, while it was being excavated.

In the shallowest part, which is opposite the Dorn Rock, there is not more than 1 foot 6 inches depth at the low water of spring tides, and from 4 to 5 feet at neap tides.

Correct sections at different places of the harbour were taken by Mr. Drane.

The calculations since made, show that to give 7 *feet* at all places during the low water of spring tide, will require 16,000 cubic yards to be excavated, which, with contingent expenses, may be taken at 3,000*l.*

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* The actual size of the cove is about 200 feet by 100 feet.

APPENDIX C.

PORTPATRICK.

No. 433.
Walker, on repairing the Works of the Harbour, and proposed Improvements.

I have stated the inconvenience suffered by the packets, even when moored at their berths, from the very heavy run of the sea during southerly and westerly gales, which sweeps round the interior of the harbour, having nothing to oppose or break it.

In the formation of rough jetties or breakwaters to assist in preventing this, and for some minor improvements, I think that 1000*l.* would be usefully applied.

An abstract of the various items of estimate is appended; the total, including contingencies and expenses, is 10,000*l.*

Your last direction to me is, to report on the expediency and expense of completing the north pier, and other works contemplated in the original plan.

My decided opinion is, that, under present circumstances, and having reference to the heavy expense, it is not expedient to do more than secure the works of the north pier in their present state, for which I have already allowed the sum of 500*l.*

The formation of the inner harbour, the introduction of steam, and the stank or dam on the east side of M'Cook's Island, which closes the harbour, and forms a breakwater to it on that side, have placed things in a very different position from that when the late Mr. Rennie proposed the north pier and its jetty.

Still I do not mean to say that the pier would not be useful in protecting the entrance of the outer harbour from north-west gales, and that if the *permanent* packet station should ultimately be fixed at Portpatrick, something of the kind may not be expedient, but it is not immediately wanted; and until the lines and extent of railroad between England, Scotland, and through the west of Scotland to the Firth of the Clyde, and the coast, are more definitely settled, I think it impossible to say what may ultimately be the best ports for the Irish and Scotch mails. Time will develope facts, of which at present there is little idea.

The improvements in progress upon the harbours of Greenock, Ardrossan, and Belfast, as well as the increasing speed and certainty of steam-packet communication, may much affect the question, and remove Portpatrick from being, what, all circumstances combined, I think it at present is, the preferable point on the Scotch coast. This opinion is further strengthened by my finding that the estimate for the completion of the north pier and jetty, according to the late Mr. Rennie's plan, is nearly 35,000*l.*

These are both founded, but are still from 11 to 12 feet under low water.

I do not participate any considerable outlay after the works I have recommended in this report shall be completed, unless a breach takes place, which the works recommended will tend to prevent.

I have, &c.,
J. WALKER.

The Right Hon. Sir George Clerk, Bart.

General Estimate of Outlay proposed in foregoing Report.

		£.
1. Expense necessary for preserving existing works:		
Repairing breach in south pier, including certain extras	£3500	
Stone rubble in angle between pier and jetty	500	
Securing north pier	500	
		4,500
2. Expense of proposed Improvements:		
Dredging and deepening harbour to 7 feet below low water	3000	
Jetties and minor Improvements	1000	
		4,000
Total proposed Outlay		8,500
Contingencies and Expenses		1,500
		£10,000

No. 434.

Sir J. RENNIE, on *the fitness of Portpatrick for a Packet Station.*

No. 434.
Rennie, on the fitness of Portpatrick for a Packet Station.

SIR GEORGE,

London, June 16, 1843.

WITH reference to Portpatrick harbour, there is perhaps no subject which has been more repeatedly discussed, and still the same conclusion has been arrived at, namely, that it is the best station.

The following is a short history of the transaction, as far as I can find it to be correct. It was established previous to 1770, experience having proved it to be the shortest and best passage.

In 1770 the celebrated Smeaton reported in favour of it, and gave a plan for the old harbour, which was partially adopted. In 1808, Captain M'Kerlie, of the navy, and the late Mr. Telford were appointed by Government to investigate the merits of the station, and they recommended Bangor Bay, on the Irish coast, and Ardwell Bay, on the Scotch coast, which is about 11 miles east of Portpatrick, in preference to Donaghadee and Portpatrick.

In 1812 the late Mr. Rennie was appointed by Government to examine the coast, and prepare the established necessary surveys, but gave no opinion as to the proper places for packets.

The whole of Mr. Rennie's plans, together with those of Mr. Telford and Captain M'Kerlie, were referred to the Trinity Board, who, on the 9th February, 1818, decided that Portpatrick, on the Scotch side, and on the 6th October, 1819, that Donaghadee, on the Irish side, were the best ports for the station. The Government then ordered Mr. Rennie to prepare the necessary plans for harbours at those places; and Acts of Parliament were accordingly passed in 1820, empowering the Government to advance funds to carry the plans into effect.

In 1823, before any considerable progress had been made at Portpatrick, the subject was again taken up by a Committee of the House of Lords, which, after hearing evidence as to the eligibility of other places, such as Greenock, Ardrossan, the Troon, Belfast, Bangor, &c., decided to leave undisturbed the stations at Portpatrick and Donaghadee.

APPENDIX C.

PORTPATRICK.

No. 434.
Rennie, on the fitness of Portpatrick for a Packet Station.

In 1830 the subject was again taken up by the House of Commons, and still the same decision was made as to Donaghadee and Portpatrick being the proper stations.

In 1834 a commission was appointed by Government to investigate the subject again, when no alteration was decided upon.

In 1836 the subject was revived; but still nothing was done. Captain Beechey reported against Portpatrick and Donaghadee, and recommended new harbours at Loch Ryan and Loch Larne, and that Donaghadee and Portpatrick should be abandoned.

In 1840 Captain Baddeley, of the Royal Engineers, was sent to Portpatrick by order of the Treasury. I did not hear the result of his report, but understood that it recommended the works to be completed.

In 1842 a Committee of the House of Commons was appointed, and, after hearing evidence from all the various other places and parties interested, came to no conclusion; but on the 13th July, 1842, the Admiralty, who had devoted considerable attention, and had investigated the whole subject thoroughly, gave their opinion in favour of Portpatrick and Donaghadee.

Thus there have been nine different investigations upon the merits of this station, all of which have been favourable to its continuance, with the exception of that of Messrs. Telford and M'Kerlie and Captain Beechey, who reported against it; but the Post-office Commission of 1834, I believe, as well as the Committee of the House of Commons of 1842, gave no positive opinion.

With regard to the causes of the original estimate of Portpatrick harbour having been exceeded, it may be observed, that a sum of 12,500*l.* has been expended in removing rocks from and enlarging and deepening the north harbour, in order to accommodate steamers before the outer piers could be completed. The work was pointed out at the time, and approved of before being carried into effect. The same may be said of the sum of 3,500*l.* expended in removing rocks from and repairing and deepening the south or old harbour. These works were not included in Mr. Rennie's original estimate.

2nd. In consequence of the repeated discussions which have continually taken place as to the propriety of continuing this station, the successive Governments *very properly did not feel themselves justified* in carrying on the works with that vigour which they otherwise would have done; the works have therefore been in progress ever since the year 1820, (twenty-three years since,) whereas six or eight years would have sufficed if pursued vigorously. The commissioners have thus been compelled to keep up an establishment for nearly the whole time at very considerable extra expense, which would have been saved if the works had been finished within the usual period.

3rd. *For the reasons above given*, the money has been granted in such small sums that it was impossible to carry on the works in that wholesale and energetic manner, by which alone economy can be practised and accidents avoided, particularly in such an exposed and stormy situation as Portpatrick; so that it was very difficult, if not impracticable, to make accurate estimates; indeed, for several years only permission was given to proceed with one pier at once, and no contractor could be found to undertake to complete the harbour under such circumstances; the extra cost occasioned by this has been very considerable.

4th. It should be recollected, that the whole of the works have been kept in repair by the sums granted, as well as in carrying on new works; and even supposing a harbour to be completed, it is impossible but that occasional repairs will be necessary, to which all harbours are more or less subject, and which ought to be allowed for, as no estimate is supposed to contemplate keeping the works in repair, but simply the first cost.

5th. The very severe hurricane of January, 1839, occasioned damage to the extent of 13,800*l.*, which was further increased by the money for the repairs not being forthcoming at the proper time, and it also prevented the north pier from being completed; and the present increased estimate arises from its being advisable to construct the new works more substantially than originally intended, in order to provide against similar accidents.

6th. The present estimate of 32,139*l.* required to complete the harbour, includes an item of 7,865*l.* for deepening and enlarging the inner harbour, which was never included in any estimate.

I trust that the above explanation will be satisfactory as to the reasons why the estimate has been exceeded.

With regard to future proceedings, the question now stands thus: to complete the outer harbour as far as is necessary, and repair the south pier, it will require the sum of 24,274*l.*; and to enlarge and deepen the inner north harbour, so as to enable steam-vessels to enter *at all times*, will require the sum of 7,865*l.*, making a total of 32,139*l.*; but if the works be confined to merely keeping the south pier in repair, and deepening the entrance to the north harbour, sufficiently to enable packets to enter at all times without enlarging it, (these works are by far the most important at present,) then the sum required will be only 9,500*l.*, besides the establishment, of which 3,500*l.* should be granted this year. If, therefore, it be desirable to limit the expenditure upon this station, it may be thus effected, and two of the most important objects gained; there will then be time for deliberation as to whether it will be advisable to do anything further, and to endeavour to obtain a contract, or to complete them for a specific sum.

It is also a matter for serious consideration, whether it would not be advisable to have a new packet capable of performing the passage in little more than half the time now occupied by the present packets; such a packet, if properly constructed, would not draw more water, or exceed the cost of working one of the present insufficient packets, and would at once establish the superiority of this station for economy and despatch in the transmission of the mails.

It is probable that one good packet would be sufficient, with the occasional assistance of one of the old packets to work this station, and thus great economy would be effected, and probably persons might be found ready to contract for working this station for much less than the actual cost to the Government.

I would, therefore, humbly submit the propriety of bringing this long-protracted discussion to an early decision, as the public interest is suffering severely by the delay. For further observations I beg to refer to my Report to Sir John Barrow, of the 23rd April, 1842.

I am, &c.,
JOHN RENNIE.

The Right Hon. Sir George Clerk, Bart.

PORTPATRICK.

No 435.
Evans, on Portpatrick Harbour.

No. 435.

Report by Captain GEORGE EVANS, R.N., *on Portpatrick Harbour.*

January 31, 1846.

AFTER a careful examination of this port, I see no reason to alter the report I made of it in 1836, and which has been confirmed by every naval officer that has been subsequently applied to; namely, that Portpatrick is not, nor ever can be made, a safe harbour, either to run for or depart from in westerly or south-westerly gales, without incurring a most enormous expense.

The plan which I have the honour to submit will shew the nature of the port better than any description that I can give of it in writing. It will be seen that it lies open to the prevailing winds from the westward and south-west which cause a heavy sea to roll into it, and with such violence as to prevent any vessel lying in the outer harbour, or even in the inner one, without sustaining injury to her hull, fastenings, or engines.

The only way to subdue the swell in the inner harbour would be to remove the old pier that tends to direct it there; but the doing so would leave no place of shelter to the few small vessels trading to the port.

The present small steamers employed to convey the mails cannot get in or out of Portpatrick at low water, there being only 3 feet water over the bar leading to their berths. In spring tides they lie aground, even in their berths, at low water. This circumstance not only prevents any regularity in the arrival or departure of the mails, but would render any attempt at their acceleration by a railroad useless.

During westerly and south-westerly gales even steamers cannot enter or depart from Portpatrick without imminent risk of life.

On *entering*, if it be *low water*, they must run aground on the bar, and lie exposed to the sea: if there be water *over the bar*, they must depend on catching the check-ropes, when passing M'Cook's Craig; for, if they miss them, they run the risk of being knocked to pieces against the cliff.

On *departing* there is so little room to get way on the vessel, that if she struck with two following seas at the entrance, she would in all probability lose her way, and fall off with her head towards the pier or rocks, rendering it impossible to give her either head or stern way with the engines; so that she must either be dashed against the piers, or driven into the harbour, against M'Cook's Craig, there being no room to turn her, either by dropping an anchor, or the use of sails or engines.

Should any accident occur to the engines, on the first shock they receive in going out between the pier-heads, the vessel must be dashed to pieces.

The light-house, which was being erected on the south pier head when I was there in 1836, has not been lighted since 1839. It cannot be approached in bad weather; the green sea breaks 30 feet over the lantern, and the pier it stands on is so frequently under water that it has the appearance of a half-tide rock. I understand that in consequence of the foundation of the south pier giving way, which threatened the destruction of the light-house, a vast quantity of stones, weighing several tons each, were a few years ago thrown into the outward angle of the south pier and jetty (in the spot marked A. on the plan).

These large blocks, instead of protecting the masonry during the westerly gales, acted as battering-rams for its destruction, being hurled against the angle with such force as to cause considerable damage. They finally disappeared, having been driven in various directions after pounding themselves to pieces.

The north pier, as will be seen by the plan, fortunately has not been finished; for if it were, it would be a very hazardous experiment to steer a vessel into the harbour during a south-westerly gale.

At present the swell, which rebounds from the south pier and jetty across the entrance of the harbour, expends itself amongst the rocks on the north side; but were the north pier finished there would be a check and rebound from it that would so agitate the entrance as to defy any man to steer through it.

In short, however suitable Portpatrick might have been, and no doubt it possessed great advantages when *small* sailing sloops were employed to convey the mails, it is clearly manifest that after the introduction of steam-vessels it should have been abandoned, not only from its incapability of admitting steam-vessels of sufficient length and power to ensure a regular and safe passage across the stormy seas, but because there were other ports not far off better situated with regard to mail deliveries, and which might be entered or departed from in perfect security in any weather, and by the largest class of steamers, namely, Loch Ryan and Loch Larne.

Were Loch Ryan and Loch Larne at present adopted, it would only be necessary to erect a jetty at Cairn Ryan, as Mr. Agnew offers the use of his jetty at Larne gratis.

Should a fair trial be given to ascertain the relative merits of the present route *viâ* Portpatrick and Donaghadee, and the route I have the honour to propose by Loch Ryan and Loch Larne, the mails and passengers could be embarked at Cairn Ryan in any weather, and the pier need not be constructed till the result of the trial would enable a decision to be formed.

DONAGHADEE.

I beg to submit a plan of this harbour which will give a much better idea of it than any description of mine.

A reference to the soundings, marked red, which I took last month, will shew the extent the harbour has silted up since I sounded it in 1836.

I found a quantity of large stones extending from just inside the entrance to a "puddle dyke" in the centre of the harbour that had never been removed: those stones have been washed into the harbour from the glacis, during easterly and south-easterly gales, and ought, together with the puddle dyke, to have been removed.

Donaghadee, in its present contracted and shallow state, will not admit of larger steamers than those now employed, and even they find great difficulty in entering it at low water, during easterly gales.

There is no serious objection to Donaghadee as a packet station, it being situated on a weather-shore, during the prevailing winds, and frequented by the packets during daylight only: it might be

APPENDIX C.

PORTPATRICK.

No. 435.
Evans, on Portpatrick Harbour.

deepened 10 feet all over; but it is evident, however, that it is too small to be of any service as a harbour of refuge.

It will always require an annual expenditure to keep it up, and has not capacity for admitting that length of vessel which alone could ensure regularity and safety in conveying the mails across those seas.

BELFAST.

I have the honour to submit a plan, shewing the improvements that have taken place in this harbour since I reported on it in 1836. All that part coloured brown is entirely new, consisting of embankments formed, and a cut made and deepened to 9 feet at low water. They are at present excavating and deepening the river from the bridge down to the cut, and widening the quays at the north or town side of the river to meet the rapidly increasing demands of the trade. When these works shall be finished, vessels drawing 9 feet water will be able to get up to the quays of Belfast at low-water springs.

There will be always some difficulty in navigating the tortuous part of the channel, until the second cut is made (particularly in thick weather or dark nights,) owing to the great length of the steam-vessels now generally in use. When the second cut is made down to Garmoyle, the channel will be straight. Gas lamps may be placed at intervals along the embankment which would enable steam-vessels to run up and down at all times, as easily as a carriage goes along the street. As a port of communication with Scotland and the north of England, there is no doubt but a great many passengers would find it very convenient to be landed at Belfast; yet it must be remembered that the sea passage between it and Cairn Ryan is 15 miles longer than that between the Cairn and Larne, and although those 15 miles are performed in the comparatively smooth water of Belfast Lough, considerable delays might reasonably be expected from navigating it in thick weather, or dark nights, particularly among the shoals at the upper and narrow part of it: on the other hand, passengers or mails landed at Larne might be sent in two directions. Those for the northern parts of Ireland might go direct by a railroad to Ballymena, or by the new road along the north coast of Antrim to Coleraine, Londonderry, Donegal, and Sligo, while the other portion destined for Belfast, and the whole of the centre and south of Ireland, would find a rapid and economical mode of transmission by means of a railroad to Belfast. It is therefore reasonable to suppose that a majority of the passengers would prefer the safest and most expeditious sea passage, which is manifestly that between Loch Ryan and Loch Larne, in consequence of there being no limit to the size or power of the steamers which might be placed on that line.

Having complied with your instructions by reporting to the best of my ability on the present state of Loch Larne, Loch Ryan, Portpatrick, Donaghadee, and Belfast, I humbly submit for their Lordships' information the following trials I made last month, (December, 1845,) to test the relative merits of the route by Portpatrick and Donaghadee with that by Loch Ryan and Loch Larne, as represented in the enclosed sketch of the Irish Channel.

On the 22nd of last month I went, during one of the hardest gales we had this winter, from the west-north-west, in the Albion, an iron merchant steamer, from Stranraer to Belfast (49 miles) in five hours and a half.

The Albion is about 200 tons burthen, has 130 horse-power, and draws, when loaded, $6\frac{1}{2}$ feet water. She had a full cargo, and averaged nine miles an hour against the gale. I timed her from passing Cairn Ryan to abreast of Larne, and she ran the distance (30 miles) in three hours and a half.

This, considering the circumstances of wind and weather, is as long a passage as would occur during the year between Cairn Ryan and Larne.

I also went on the 17th of last month in the "Pike" mail boat, Lieutenant Boyton, from Donaghadee to Portpatrick. The water was smooth: we had a leading wind, and the sails were set; yet, owing to the limited size and power of the boat, we were two hours and fifty minutes running across (19 miles).

This clearly proves the great superiority of the Larne and Loch Ryan route; for the Albion went against the hardest gale we had this winter two miles an hour faster than the largest boat that could enter Portpatrick could go in fine weather with a fair wind.

The mail boats during adverse gales are obliged to tack, under steam and canvas, across the channel, having neither length nor power to stem the gale.

The "Pike," Lieutenant Boyton, was, under such circumstances, nine hours and a half crossing, a few days before I went in her.

It will naturally occur to ask, Why has not the route *viâ* Portpatrick been abandoned long ago if there be such objections to it? The reason is easily explained. When the Commissioners of Inquiry into the Post-office Department, in 1836, strongly and unanimously recommended in their report (Sixth Report of the Commissioners appointed to inquire into the Department of the Post-Office, 1836) that no further expense should be incurred on Portpatrick or Donaghadee, and that Cairn Ryan and Larne should be adopted as the best route for the mails, the proprietors of Portpatrick and the civil engineer stated that if the money then voted for the completion of Portpatrick (23,700*l.*) were expended on it, the harbour would be rendered perfectly safe, and possess ample accommodation for the reception of first-class steamers drawing 12 feet water and upwards.

Although the Lords of the Treasury had complied with the recommendation of the Commissioners of Inquiry, by stopping the works and paying off the workmen, yet their Lordships, considering that nearly 150,000*l.* public money had already been spent on Portpatrick, and that the engineer was quite confident of success, their Lordships consented to go on with the works

The present state of Portpatrick sufficiently explains the result.

Under these circumstances, it is my humble opinion that it is well worthy of their Lordships' consideration, whether a fair trial of the two routes is not desirable. By granting it, their Lordships will settle a question which for many years has been the cause of considerable anxiety to the bankers, merchants, and manufacturers of Scotland and the north of Ireland.

I have, &c.,
GEORGE EVANS, *Captain, R.N.*

To the Secretary of the Admiralty.

No. 436.
Rennie's Observations on Captain Evans's Report on Portpatrick.

No. 436.

Observations by Sir J. RENNIE *on* Captain EVANS's *Report on Portpatrick.*

GENTLEMEN,

London, April 9 1846.

HAVING been officially called upon, with the sanction of the Lords Commissioners of the Admiralty, to reply to Captain Evans's report of the 31st January last, on the harbour of Portpatrick and Donaghadee, and on the propriety of adopting either Larne and Loch Ryan, or Loch Ryan and Belfast, as the stations for carrying on the Post-office communication between the south-west of Scotland and the north-east of Ireland, in preference to the long-tried and established harbours of Donaghadee and Portpatrick, and thus to abandon a station which has been tested by the experience of two-thirds of a century, and upon which nearly 300,000*l.* of public money has been expended, I beg leave to do as follows.

The subject has been so often discussed and investigated, and has always terminated in the same result, viz., the establishing the superiority of Donaghadee and Portpatrick as the best station, under all the circumstances, that it might be supposed unnecessary to agitate the question further; and the recent report of Captain Evans, above alluded to, only contains the same arguments which have been so often refuted before; still, however, a reply may be considered necessary by some, in order to prevent these erroneous opinions from being again entertained and circulated.

This station was first established by experience, and about the year 1770 was improved, and recommended by Smeaton, and others, as the best for the object. It continued in this state without further alteration until the year 1808, when the late Mr. Telford and Captain M'Kerlie were appointed by Government to ascertain whether any, and what other, could be found better adapted for the purpose, and whether this station could be improved: they recommended the adjacent harbours of Port Nessock, on the Scotch, and Bangor, on the Irish side, as preferable; their recommendation, however, was not acceded to.

In 1812, the late Mr. Rennie was appointed by Government for the same object, and he prepared the necessary documents, and furnished the required information, when the whole was submitted by the Government to the decision of the Trinity Board, who finally decided upon Donaghadee in 1819, and Portpatrick in 1820, as the best stations.

The Government then directed Mr. Rennie to prepare the necessary plans for improving these harbours, and Acts of Parliament were passed, empowering the Government to appoint commissioners, and supply the necessary funds for carrying Mr. Rennie's plans into effect.

The works accordingly commenced in 1821. Donaghadee was finished in 1836, and Portpatrick is nearly complete, as described in the accompanying plan—with the exception of the north pier-head and jetty, which have been stopped by order some years since, and the deepening of the entrance to the north harbour to the depth of 7 feet below low water of spring tides, which is in progress—and in 1825 steam-boats were first introduced on this station, and although the harbours have been unfinished, and the boats are old and inefficient, still, notwithstanding these great disadvantages, the mails have been carried with a degree of expedition and regularity surpassed by no other station between Ireland and Scotland. In 1823, before the works had proceeded far, a committee of the House of Lords was appointed to investigate the merits of the station; and after comparing it with all the neighbouring ports of Loch Ryan, the Troon, Ardrossan, Port Nessock, Belfast, Bangor, &c., confirmed the report of the Trinity Board, and the works were ordered to be continued. In 1830 another committee was appointed by the House of Commons. The subject was again investigated, and the same conclusion as those of the Trinity Board and the House of Lords was the result. In 1834 and 1836 Post-office commissions were appointed, but came to no definite result upon this station. In 1840 Captain Baddely was appointed by the Treasury to examine Portpatrick, and he recommended the works to be completed. In 1842 the subject was investigated by the Admiralty, and they decided in favour of Portpatrick and Donaghadee, and the same year another committee of the House of Commons was appointed, but after hearing much evidence, they came to no decision upon this point. In 1843 Mr. Walker was appointed by the Treasury to examine Portpatrick, and recommended the works to be continued, and upon his recommendation, a grant of 10,000*l.* was made by Parliament for that object, a portion of which is still unexpended. Thus we find, after repeated investigations and discussions carried on by the most competent authorities during the period of above seventy years, with all the facts before them, the majority, or nearly the whole of these decisions, were in favour of continuing the present stations of Portpatrick and Donaghadee. The reasons which guided and influenced those decisions I believe may be stated as follows:—

1st. The distance between Portpatrick and Donaghadee, is the shortest in this quarter, scarcely exceeding 21 miles, or 19 miles as stated by Captain Evans. This, on a sea voyage for Post-office communications, where the utmost regularity and dispatch under all circumstances are indispensable, is most important, and cannot be too strongly insisted upon; for so long as the journey is performed by land, the time may always be calculated upon with almost unerring certainty to a few minutes, and since the introduction of the railway system, the speed upon land may be taken at three times that which can be attained at sea, even under the most favourable circumstances, but during winter and stormy weather, the advantage in favour of the land journey is immensely increased. Every means, therefore, which can be adopted to shorten the sea voyage, ought to be carried into effect, for at sea the uncertainty and delay invariably take place. So completely is this principle now admitted and recognised, that the Government have, I understand, determined to expend a large sum in improving Holyhead harbour, and to contribute a large annual sum to the Chester and Holyhead Railway Company, abandoning all their other stations, because this is the shortest sea passage in this quarter, and is the only sure means of obtaining the most certain, expeditious, and economical communication with Ireland, and in this they have acted wisely. Upon what principle they should be called upon now to determine otherwise in communicating with the north-east of Ireland and the south-west of Scotland, I am at a loss to understand.

2nd. Another very important element in making the passage, is the set, direction, and duration of the currents of tide. These are decidedly in favour of Portpatrick and Donaghadee.

3rd. The south-west coast of Scotland is a lee shore, with the prevailing winds, which blow from southerly and westerly points for three-fourths of the year, and chiefly during the winter and spring months; the shortest passage, therefore, is of the utmost consequence.

4th. The coast is bold and clear of rocks and shoals, the soundings regular and deep, close to the

APPENDIX C.

PORTPATRICK.

No. 436.
Rennie's Observations on Captain Evans's Report on Portpatrick.

shore; therefore, the ports are easily made, and run for with confidence, which is a great advantage in making a passage in short days, dark nights, and foggy and stormy weather.

5th. Much smaller packets can work the station, as well as a smaller number, consequently the station can be worked far more economically. Captain Evans omits even the very mentioning of these decided advantages, and upon which alone the question ought to be decided, and which, hitherto, have always been taken into consideration, and contrary to what is now so universally recognised and adopted, viz., the shortest sea passage, he recommends the longest to be taken, and compares the natural harbours of Loch Ryan, Larne, and Belfast, with the artificial harbours of Portpatrick and Donaghadee, which form only one part of the question, and omits to mention the great superiority of distance, winds, tides, currents, &c.

Assuming, however, that Loch Ryan and Larne be adopted for the station, as recommended by Captain Evans,—the distance between them is from 34 to 35 miles, or 15 miles more than Portpatrick, and as, during heavy gales, which so frequently occur here, it would be contrary all the way across the passage, even with a powerful steamer it could scarcely be accomplished under five or six hours, if so little, and when at Larne, the distance to Belfast is 21 miles, this, even with a railway, and the journey from Loch Ryan would scarcely be accomplished under seven hours; whereas by Portpatrick and Donaghadee, with the land journey by railway, (Bills for making which are now in Parliament,) the journey would be accomplished in three to four hours, or in half the time.

Again, as regards the passage between Loch Ryan and Belfast, it is only necessary to use Captain Evans's own words, as conclusive against it, viz., "That the sea passage is 15 miles longer than between the Cairn and Larne, and although these 15 miles are performed on the comparatively smooth water of Belfast Lough, considerable delays might reasonably be expected from navigating it in thick weather or dark nights, particularly among the shoals of the upper and narrow parts of it."

Again, as regards expense, Captain Evans, in order to accommodate the packets at the Cairn and Larne, recommends that two new piers should be built, of about half a cable's length each, in from 14 to 15 feet of water, besides the necessary buildings for stores, &c., repairing shops, &c. The piers, upon the cheapest plan, would cost from 30,000*l.* to 40,000*l.* each, and if made to withstand a heavy sea, would require a great deal more, and the other buildings from 5,000*l.* to 10,000*l.* more, so that the two new establishments would not be taken at less then 100,000*l.*; but if accurate plans were performed, I dare say it would amount to a great deal more. Wood is scarely adapted for works of this kind, as the sea-worm is very destructive, and if adopted, would require frequent repairs and renewal in a comparatively short time; thus in the end no saving would take place, by not constructing the works properly of stone in the first instance, which would be very expensive. The packets, moreover, would require to be of greater size and power, viz., from 200 to 300 horse power. The expense of steamers of that class cannot be taken at less than 30,000*l.* each; and to work the station effectually, three would be necessary, at a total cost of 90,000*l.*; the interest of the first cost would be 4,500*l.*, and the expense of working the same 5,700*l.*, according to parliamentary returns, each, and with the two constantly at work, would be 11,400*l.* per annum; therefore, taking the interest of the two new stations, including repairs, at 6 per cent., the total annual cost of the two new stations, would be as follows:—

Interest, capital, and repairs of two new stations, at 100,000*l.*	£6,000
To interest of three new packets, at 30,000*l.* each	4,500
Expense of working two packets	11,400
Total annual cost	£21,900

Comparing this with Portpatrick and Donaghadee, we find, cost of completing Portpatrick harbour taken at 30,000*l.* This, at 6 per cent	£1,800
To maintenance of the other works at Portpatrick and Donaghadee	1,000
To two new packets, 100 horse power, 10,000*l.* each	1,000
To cost of working two packets	4,000
Total annual charge	£7,800

Deducting this from the former, leaves a clear annual saving in favour of the Portpatrick and Donaghadee stations, 13,100*l.*; but inasmuch as these stations, for by far the greater portion of the year, could be worked by one packet, a further saving from 1,000*l.* to 2,000*l.* would be made, so that the total saving would not be less than 15,000*l.* per annum, as stated in my report of the 26th April, 1842; and if to this be added the great saving in time, and superior regularity in delivering the mails, as above stated, there cannot be a doubt but that the present station is the best under all the circumstances, and confirms all the previous resolutions in its favour.

Captain Evans's observations about the present harbour of Portpatrick, (for he almost admits Donaghadee answers the purpose,) are not to the point, for it should be recollected that the harbour is not yet finished, and notwithstanding this, and the deficient packets, there is no station between England and Ireland where the mails are at present carried with greater regularity and certainty; but when finished, and proper packets are put on the station, which can readily be accomplished, I am decidedly of opinion, notwithstanding the statement of Captain Evans, from long experience, that the mails will be carried, and the communication preserved between England and Scotland, in a more expeditious, certain, and economical manner, under all the circumstances, than at any other that could be established in this quarter.

If any further information be required, I beg leave to refer you to my reports of the 25th April, 1842, to Sir John Barrow, and to Sir George Cockburn of the 16th June, 1843, and to the numerous others which are already in your possession.

I am, &c.,
JOHN RENNIE.

To the Commissioners of Portpatrick Harbour.

P.S.—Since my report of the 9th ultimo, I have again considered Captain Evans's report, and have only to add, in reply to his observation, viz.:—"That Portpatrick lies open to the prevailing winds from the westward and south-west, which cause a heavy sea to roll into it with such violence, as to prevent a vessel lying in the outer harbour, or even inner one, without sustaining injury to her hull, fastenings, or engines; that should any accident occur to the engines in the first shock they receive in

APPENDIX C.

PORTPATRICK.

No. 436.
Rennie's Observations on Captain Evans's Report on Portpatrick.

going out between the pier heads, the vessel must be dashed to pieces;" and, speaking of the light-house, he says, "the green seas break 30 feet above the lantern."—As regards the first part of this paragraph, the outer part of the north pier is not complete; when it is, the sea which now enters will be effectually prevented, without creating any difficulty either in the entering or departing, as stated by Captain Evans; but even at present, the packets lie perfecly safe, and if more accommodation be required, there can be no difficulty in constructing a proper basin, at a moderate expense, on the flat ground behind the north pier. As to any accident which might happen to the engines on going out, a packet in this case would be in no worse situation than at any other port under similar circumstances. But this never has occurred during twenty-one years, even with the present most inefficient packets, and is much less likely to occur with one of the superior modern packets. But even supposing it should happen to one of the engines, it is more than probable it would not happen to both; and as the wind in that case would be favourable for returning, she would have no difficulty in getting back to her moorings. By way of illustration, it is only necessary to add, that durng the memorable hurricane of the 7th January, 1839, the brig "Amity," of Ayr, breaking from her moorings in the Lough of Belfast, with the wind precisely under the circumstances mentioned by Captain Evans, steered for, and obtained refuge for herself and crew in, Portpatrick harbour. As to the "green seas," perhaps Captain Evans means "spray." In fact, the more I consider the subject, the more I think that the opinions of Captain Evans, as regards this harbour, are erroneous.

J. R.

No. 437.
Wrecks in the vicinity of Portpatrick, 1828-45.

No. 437.

List of Wrecks in the Vicinity of Portpatrick, from 1828 *to* 1845, *between Corsewall Point and Dunman Head.*

Date.	Name.	Rig.	Belonging to	Exact spot where Wrecked.	Wreck, or got off.	Lives lost.	Remarks, &c.
1828	Stag . .	Sloop .	Greenock . .	Ebbstone . . .	..	..	8 m. North of Portpatrick.
1832	Crown . .	Brig .	Greenock . .	Ebbstone . . .			
,,	——— .	Brig .	..	Portaspittal Bay .	Total wreck	..	3 m. South.
,,	Little John .	Schooner	..	Ward Bay . .	Total wreck	..	1 m. North.
,,	Harrat . .	Brig .	New Brunswick	Killantringan Bay.	Total wreck	..	8 m. North.
,,	John . .	Brig .	Kincardine . .	Portaspittal Bay .	Total wreck		
,,	Bulwark .	Schooner	Cork . . .	Portpatrick . .	..	..	Put in from stress of weather.
1835 Feb. 2	Lion . .	Ship .	Boston . . .	1 m. South of P. P.	Total wreck	11	
1836 Jan. 3	Wm. Allan .	Brig .	Belfast . . .	Portaspittal Bay .	Wreck . .	..	3 m. South.
,,	Maria . .	Schooner	Workington .	Portpatrick Hr. .	Saved . .		
,,	Castor . .	Brig .	France . . .	Dally Bay . .	Total wreck	..	8 m. North.
,,	Betty . .	Schooner	Bideford . .	Portpatrick Hr. .	Wreck		
1839 Jan. 7	Experiment.	Schooner	Peterhead . .	Ardwall Bay . .	Total wreck	10	6 m. South; hurricane.
,,	Lund . .	Sloop .	Belfast . . .	Portaspittal Bay .	Total wreck	10	3 m. South.
,,	Amity . .	Brig .	Ayr	Portpatrick . .	Got off .	..	Driven from Anchorage in Belfast Lough.
Nov. 16	Bee . . .	Sloop .	..	Cromack Point .	Total wreck	4	10 m. South.
Dec. 24	Letitia . .	Sloop .	Carrickfergus .	Logan Head . .	Total wreck	4	7 m. South.
1840	Agnes . .	Sloop .	Glasgow . .	Portpatrick Hr. .	Got off		
1841 Jan. 3	Jane Gordon	Brig .	Ayr	Ward Bay . .	Total wreck	3	1 m. North.
1842 Nov. 9	Arthur & Rachel	Schooner	..	Carngarrock Bay.	Total wreck	..	3 m. South.
1844 Jan. 25	Æolus . .	Schooner	Belfast . . .	Parr Bay . . .	Total wreck	..	6 m. North.
Nov. 9	Venua . .	Sloop .	Drumore . .	Portpatrick Hr. .	Got off .	..	Put in through stress of weather.
1845 Mar. 28	Leonidas .	Schooner	Belfast . . .	Portpatrick Hr. .	Got off .	..	
,,	Idonia . .	Brig .	Christiana . .	8 m. North . .	Got off .	..	Went to LochRyan
Oct. 24	Lady Ann .	Sloop .	Portpatrick . .	Portpatrick Hr. .	Total wreck		
,,	Miranda .	Schooner	Belfast . . .	Corsewall Point .	Total wreck	..	10 m. North.
,,	Reform . .	Brig .	,,	,,	,,	..	,,

No. 438.
Income and Expenditure.

No. 438.

Return of Income and Expenditure for the Years 1841–2–3.

INCOME.				EXPENDITURE.			
Heads of Income.	1841	1842	1843	Heads of Expenditure.	1841	1842	1843
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Shore dues and dues on cattle . . .	7 10 0	6 18 0	7 1 0	Charges for collecting	0 15 0	0 13 6	0 14 0

Dues levied by authority of Charter. Private property.

JOHN SEMPLE, *Comptroller.*

PORT LOGAN—PORT NESSOCK BAY.

No 439.

Return to Order of the House of Commons of August 9, 1844.

No. 439.
Return to Order of the House of Commons, of the 9th August, 1845.

SIR,

Auchness, March 28, 1845.

I AM favoured with yours of the 4th ultimo, enclosing copy letters from the Hon. H. Manners Sutton, respecting the Government inquiry as to harbours, and I am desired by Colonel M'Dowall, of Logan, to forward to you the three accompanying plans of Port Logan harbour, and also other documents relating to the harbour, consisting of fourteen in number.

It is well known that the harbour of Port Logan has proved a harbour of refuge on many occasions during violent storms, when vessels were unable to take any other port, and that the mail packets from Ireland have occasionally been under the necessity of running into Port Logan.

I am, &c.,
DAVID M'CULLOCH.

To the Collector of Customs, Stranraer.

No. 440.

Report of JOHN RENNIE, Esq., *on forming a small Harbour at M'Ferrand's Isles; and Estimate.*

No. 440.
Rennie, on forming a small Harbour at M'Ferrand's Isles, and Estimate.

SIR,

London, January 25, 1813.

ACCORDING to your desire, I took a view of the bay of Port Nessock, on the 3rd and 4th November last and examined the same with great attention, but owing to the heavy gale of wind from the west-north-west, which continued during the time I was there, it was not in my power to take the soundings over the bay with that accuracy which I should otherwise have done, nor was I able to ascertain the exact situation of M'Ferrand's Isles. In fact, such was the violence of the gale, that it was unsafe to venture near to the shore at all; I was therefore obliged to get Mr. Morrison to make a survey of the bay, to take the soundings, which appeared to me necessary, to lay down correctly the situation and extent of M'Ferrand's Isles, which, under all the circumstances of the case, appeared to me the fittest place in the bay for a small harbour, such as will suit the purpose of a packet harbour; and, indeed, there is no other place in the bay where a harbour could be made to suit the purpose at any moderate expense.

By Mr. Morrison's survey it appears that the bay of Port Nessock lies open to the west, and it may be said to be bounded on the north by the head of Logan, and on the south by Carniwillan Head, for although there is another head farther south which stretches farther to seaward, yet that head is at a considerable distance from it. The width at the entrance of the bay is about a mile and a quarter and at its head something less than half a mile wide. Its depth is about three quarters of a mile. The south and north sides of the bay are entirely rock, except here and there on the north a small sandy inlet, such as Port Avadie, Clangy, Robinson Bay, &c., none of which are of sufficient extent to make a good harbour, and were they even something more extensive than they are, the rocks on either side of them are so steep and rugged, that if a vessel were to miss stays in entering a harbour made at any one of these places, she must almost infallibly be shipwrecked.

The head of the bay is a fine sandy beach with here and there small stones scattered along it, but these, if necessary, might easily be removed; therefore such a place should be chosen in the bay for a harbour, as, if a vessel should miss stays, or steer wide in entering it, she might be able to ground on this sandy beach, which would afford an opportunity of saving the crew at least, if not, the vessel and cargo; and no place in the bay affords this advantage so favourably as that near the old harbour, where the Great and Little M'Ferrand's Isles lie, which presents an opportunity of erecting a pier, close within which there is from 5 to 6 feet of depth at low-water spring tides.

The Great M'Ferrand's Isle lies about 300 yards from the head of the bay at low-water spring tides, and about 30 yards from the shore opposite to it in the line of the Fish Pond, which bears about north and by west; the soundings increase gradually from 6 to 13 feet at low-water spring tides, and from thence due west they increase gradually towards the entrance of the bay, where there is 10 fathoms. A vessel therefore may work out at this place with any wind that is not too high for her to go to sea at all, independent of any from the current of tide. But here the current of tides is most favourable, for according to the information I received from the two old men who have known this bay for most of their lives, they say that first of flood forms an eddy in the bay, and the current runs from Carniwillan Head and sweeps round the bay near to its battain, and out by the head of Logan, and continues to run northward for nearly eight hours, *i.e.* from the first flood to quarter ebb, after which it sets to the south for the last three-quarters of ebb; so that if a vessel sails out of the old harbour, or from a new one near it, at half a flood, she would be assisted by the current in getting out of the bay for nearly five hours, if so long is required; so that with the sea room the bay affords, and the assistance of the current, she could not fail to work out in any wind, if she could keep the sea at all. If working inwards from the first flood to quarter ebb, she would take the south side of the bay, and if from quarter ebb to the first of flood, the north side of the bay, where in both cases if the wind was adverse, she would be assisted in getting into the harbour by the current; and when it is taken into account that the water is deep all over the bay, except to its head, and the anchoring ground, as I am informed, good, this seems a most favourable place as a station for packets, and, indeed, as a place of resort for vessels working up and down channel, of which the draft of water does not exceed that which can be made in a harbour at this place.

I have said before that M'Ferrand's Isles seems to me the most favourable place in this bay for a small harbour; I could certainly have wished that they had been placed farther from shore and from the head of the bay. If the former had been the case, a more extensive harbour could have been made; if the latter, the vessels would have entered or come out of the harbour in greater safety, and with less risk of steering wild, from their being less under tow from the sea; but as this cannot be altered, the best must be made of the situation it will admit.

The plan I propose is to form the head of a pier on Great M'Ferrand's Isle; by this means the head and angle of the pier will be well secured against the action of the waves from Little M'Ferrand's Isle. I propose a straight kant or pier to the main-land, to extend about 60 feet beyond high-water

APPENDIX C.

PORT LOGAN.

No. 440.
Rennie, on forming a small Harbour at M'Ferrand's Isles; and Estimate.

mark, with a breast wall of about 100 yards in length, eastward from the pier, thus inclosing a space of about two acres, which will be sufficiently large for a packet harbour. I propose to have only one pier, and of the shape represented in the plan; the outer kant of which will have a clear length within the jetty of about 80 feet, and there will be a space of about 80 feet more between the inner end of this kant and the present low-water mark; thus affording room for two packets to lie in from 5 to 6 feet of depth at low-water spring tides, and as ordinary spring tides rise here about 15 feet, and neaps about 10 feet, the packets in springs will float soon after quarter flood, and in neaps before it: this will enable them to sail so as to take advantage of the current running out of the bay in proper time; but in cases of northerly winds it will be necessary to have a warping buoy placed without the harbour, for vessels to warp out of it.

Within the present line of high-water mark I propose to excavate the ground within the harbour to the depth of low-water spring tides, which will give quay room at the breastwall for vessels that are to unload or take on board cargoes out of the way of the packets, or when more packets than two are are in the harbour; space enough will be found for them towards the breastwall, in the space to be excavated.

The present old pier I propose to remain nearly as it is, only to be shortened as in the drawings, and the west side to be made with a flat slope, say of 6 horizontal to 1 perpendicular: this will require it to be a little strengthened on the east side.

By the form of pier I have given, the harbour will be sheltered against the winds, except those from W.N.W., and then only a small part will be exposed to the inrun of the sea; these seas, however, will be thrown on the western side of the old pier, which, from the flat slope I propose to give to it, will greatly quiet them, and little or no rebound will take place; indeed, even this part is so much covered by the head of Logan and the head or outer kant of the pier having its direction to the head of the bay, I apprehend little or no sea will ever enter the harbour. On the whole, therefore, I apprehend this harbour will be safe and quiet, let the wind blow from what point it may.

The estimated cost of this harbour is, however, great, amounting to 11,836*l.*, and if done in the manner proposed, I do not see how it can be done for less. It is possible, however, that the stratified whinstone in this bay may be got in such blocks as to answer the purposes of the freestone I have estimated for. In this case a considerable saving will be made, as the freestone forms a large item in the estimate, particularly in the parapet, &c., and the base of the inside pier, coping, cordon, &c. If whinstone can be got to answer these, the total sum will, of course, be greatly reduced; if they cannot, I despair of saving anything out of the sums I have estimated, to render the harbour complete for packets. But if it is intended as a harbour only for the purpose of importing lime, &c., for the use of your own and the neighbouring properties, and for the exportation of corn, potatoes, &c., then many of the works I have proposed may be saved, such as excavating the ground from high to low-water mark, the breastwall, the cut sluice, parapet, &c., &c. The saving of these will reduce the estimate to 6,480*l.*, and if the whinstone will answer in place of freestone, a farther deduction will be made; still preserving the original principle of the harbour, and which will enable the whole plan at any future period to be carried into execution. A light-house will also be wanted, but this need not be entered into at present.

I am, &c.,
JOHN RENNIE.

Andrew M'Dowall, Esq., Logan.

Estimate of the probable Expense of a Pier, Breastwall, and Harbour, proposed to be made at Port Nessock, conformable to the plan.

	£	s.	d.
2,265 cubic yards of strong rubble masonry in the outside wall of the pier and head, at 13*s.*	1,472	5	0
241 ditto in counterforts to ditto, at 10*s.*	120	10	0
815 ditto in outside wall of pier, from low to high water, at 10*s.*	407	10	0
85 ditto counterforts in ditto, at 8*s.*	34	0	0
4,600 cubic feet of Ashlar in ditto, extra, at 1*s.*	230	0	0
3,900 ditto ditto in cordon, at 2*s.*	390	0	0
18,000 ditto ditto in parapet, at 2*s.*	1,800	0	0
5,940 ditto ditto in case of inside pier under water, at 2*s.* 6*d.*	742	10	0
1,661 cubic yards of strong rubble masonry in inside wall, at 10*s.*	830	10	0
221 yards of counterforts, at 8*s.*	88	8	0
1,900 cubic feet of Ashlar, in through course of pier, extra, at 1*s.*	95	0	0
2,550 cubic feet of coping, at 2*s.*	255	0	0
2,200 cubic yards of rubble case, at 4*s.*	440	0	0
6,560 cubic yards of filling between walls of pier, at 1*s.*	328	0	0
1,022 square yards of paving, at 3*s.*	183	6	0
1,222 cubic yards of strong rubble breastwall, at 8*s.*	488	16	0
900 cubic feet of Ashlar coping, at 2*s.*	90	0	0
24,900 cubic yards of excavation in the harbour, to be used as above, at 1*s.* 6*d.*	1,867	10	0
Contingencies	1,972	15	0
	£11,836	0	0

No. 441.

Young, on forming a Breakwater in Port Nessock Bay.

No. 441.

Report by JOHN YOUNG, Esq., *on forming a Breakwater in Port Nessock Bay; with* Mr. MATHIESON's *Specification and Estimate.*

SIR, *Port Nessock, March* 29, 1820.

ACCORDING to your desire, I have taken a view of the bay of Port Nessock, and beg leave to observe, that if a breakwater were to be made, as is proposed, in 23 feet of water at low-water spring tides, giving 20 feet of water on the inside for vessels to ride in for a considerable way, and 400 yards long, 300 yards width at each end for entrance, there would not be a better place in the island for vessels to resort to in stormy weather, it having such an easy approach, with neither rock nor shoal; is sheltered by nature against the wind from N.W. to E., and from E. to S.W. It could be made at a moderate expense, as both sides of the bay are rock: the stones can be got with great facility, particularly at the south-west, near Carniwillan Head. When the winds are taken into account, as they blow nearly two-thirds of the season from S. to W., this place would be well adapted for the safety of vessels when loading, in the course of the operations.

From where the breakwater is proposed, the soundings increase gradually towards the entrance of the bay, where there are 10 fathoms. With such a depth of water as the bay affords, it will be capable of admitting the largest ships which are likely to be at this part of the island.

This seems a most favourable place as a situation for packets, by having the harbour as is proposed, at M'Ferrand's Isle; they would take on board or land passengers with great facility. The current in the bay is most favourable, as it is always running out on some one side.

I am, &c.,
JOHN YOUNG.

Estimate of the probable Expense of a Breakwater, proposed to be made in 23 feet of Water, at Low-Water Spring Tides, in the Bay of Port Nessock.

	£	s.	d.
128,429 cubic yards of strong rubble below low water, at 5s. . . .	32,107	5	0
54,460 cubic yards of strong rubble above low water, at 10s. . . .	27,230	0	0
Contingencies	10,500	0	0
	£69,837	5	0

The dimensions of the above to be 1,200 feet long, 23 feet to the top of low water, 15 feet to the surface of high water, and 3 feet above high water;—total height, 41 feet.

JOHN YOUNG.

Mr. MATHIESON's *Estimate of the cost of the Breakwater at Port Nessock Bay.*

SIR, *Stranraer, April* 15, 1820.

AGREEABLY to your instructions, I herewith send you an estimate of what a breakwater to be built at the bay of Port Nessock will cost, of 1,000 feet long, at top when finished, being at 23 feet water at low ebb ordinary spring tides, and to be 4 feet higher than high water. This, in my opinion, will cost say 83,000*l.*, being substantially built with whinstone, without mortar, agreeably to a description of the same.

I am, &c.,
Andrew M'Dowall, Esq., Logan. HENRY MATHIESON.

Specification of a Breakwater proposed to be executed in the Bay of Port Nessock.

Stranraer, April 17, 1820.

THE breakwater to be placed, where it is shown on the chart of the bay, where the water is 23 feet deep at low ebbs at ordinary spring tides; to be in the form of a crescent in the middle of the bay; or to have it straight in the centre part, the two extreme ends turning inwards, with a kant or an obtuse direction, similar to that just now being executed at Plymouth; but the former mode is presumed to be more advisable, as being less subject to be injured by a heavy sea, owing to the surge breaking before it covers much surface.

That part of the work under low-water mark to be done by means of dropping-stones, the base of which to be about 160 feet wide, and carried up in a sloping manner, until within 2 or 3 feet of low-water mark, where the width will be about 80 feet; then to commence with building a row of stones of large dimensions from 7 to 13 feet long, laid all headerways, with a sufficient offset; over which another course of similar dimensions, breaking band on the joints of the course below, with an offset of about 18 inches; this course to be continued one-third of the thickness of the breakwater. The next course to be of stones from 6 to 10 feet long, with corresponding heading stones; these three courses not to be less than 15 inches thick; then the work to the top to be built with the stones on their edges, in a slanting direction, properly banded and wedged; all the front stones to be of large dimensions, especially those towards the channel, from half a ton to three tons weight; the crown of the breakwater to form a round, like that of an arch, the hearting stones to be properly connected with the external. No mortar to be used, but large gravel from the shore to be washed into the apertures, so as to make the whole solid; the crown to be about 4 feet higher than high-water mark, and to be about 28 feet wide, and to have large stones with a ring on the top for fixing cables to. The whole length of the breakwater to be 1000 feet. The whole of the work to be of blue whinstone.

HENRY MATHIESON.

No. 442.
Petitions to Parliament for converting Port Nessock Bay into a Harbour of Refuge, 1820.

No. 442.

Petitions to Parliament for converting Port Nessock Bay into a Harbour of Refuge, 1820.

The Petition of the Commanders of His Majesty's Cruizers, stationed on the West Coast of Scotland, Merchants, Owners, and Masters of Vessels navigating the Channels between Scotland and Ireland, to the House of Commons,

SHEWETH,

THAT a good harbour or safe place for ships has been long much wanted upon that part of the coast of Scotland in the Irish Channel, from the Clyde towards the Isle of Man, where there are so many ships passing from all parts of the world; and your petitioners are of opinion that if a good harbour were made in the bay of Port Nessock, about eight miles north of the Mull of Galloway, it would be the fittest place for a harbour, from having anchoring ground, and being easy to get in and out with all winds, and would materially assist in the protection of the revenue and fair trader.

Therefore, the undersigned, humbly pray that your Honourable House will take their petition into consideration.

May 22, 1820.

J. REID, *Lieutenant R.N.*, *Senior Officer*,
and 43 others.

The humble Petition of Merchants, Owners, and Masters of Vessels trading from the Clyde, and Others, to the House of Commons.

SHEWETH,

THAT they undergo great hazard and losses from there not being a safe harbour of easy access upon the Scotch side of the Irish Channel. Your petitioners therefore beg humbly to represent that if there were a good harbour made in the bay of Port Nessock, about eight miles north of the Mull of Galloway, it would be the most advantageous place upon that side of the channel for ships to take shelter in, as it is well marked with headlands, easy to get in and out of with all winds, and lies near the tideway of the channel to get north or south. That Portpatrick must always be difficult and extremely dangerous of access in a gale of wind, as also frequently troublesome to get out, and whatever may be expended upon it, there is such a sameness of coast for a length of way, that it is difficult to be found in thick weather.

The undersigned, therefore, humbly pray that your Honourable House will take their petition under consideration.

HUGH COWAN, *Shipowner*, and 72 others.

The Petition of the undersigned Merchants, Owners, and Masters of Vessels belonging to, and trading to and from, the City of Glasgow, and of the subscribing Underwriters residing in that City,

HUMBLY SHEWETH,

THAT the want of safe and convenient harbours upon the west of Scotland, in which, in a storm, vessels can take shelter, has been long felt and acknowledged, there being none which can admit vessels of any size anywhere between Loch Ryan and Douglas in the Isle of Man, except Portpatrick; and the petitioners, as well as all those interested in shipping passing through the Irish Channel, are thereby exposed to great and continual risks; and have met and are daily meeting with many and very heavy losses.

That it must therefore be evident to the House that the erecting of any safe and convenient harbour on that coast, which would admit of the large merchant ships, would be of much benefit, not only to the petitioners, but to the country at large, and would also be the means of saving many valuable lives.

That your petitioners are informed that with a view in part to remedy this evil, it is proposed to suggest to the House the propriety of enlarging and endeavouring to improve the harbour of Portpatrick.

That your petitioners, however, understand that the proposed alterations will require a very large sum of money, and many things to be done of very difficult execution, it being naturally very difficult of entrance, a fault which the proposed alterations will not in the smallest degree remove; and from the lowness of the surrounding land, vessels being very apt in hazy or stormy weather to pass it altogether, the harbour will thereby be very little improved.

That considering these things, and knowing how much your Honourable House are inclined to do, or aid in anything proposed to be done, which will be of general utility, the petitioners have taken it upon them to state their wishes upon this subject, and to recommend the bay of Port Nessock, upon the coast, and within eight miles of the Mull of Galloway, as a place admirably fitted by nature for a harbour, such as is so much wanted, as it is of very easy access for the largest merchant ships; well marked by headlands, so that it is almost impossible it can be missed, even in the worst weather; safe, well sheltered, and convenient within, with excellent anchoring ground, and as your petitioners are informed, inferior to the harbour of Plymouth in nothing but extent. It may be also observed, in recommendation of this plan, that all these advantages may be obtained at a much less expense than the alterations of the harbour at Portpatrick are estimated at.

The petitioners therefore pray your Honourable House to take into your consideration the state in which the west of Scotland is from want of good harbours, and either to give orders for the erection of a good harbour in the bay of Port Nessock, or grant such aid towards it as to you may seem proper, by which you will do a lasting service, not only to your petitioners, but to all those interested in the shipping in the west of Scotland.

OWEN MORGAN, *Shipmaster*, and 82 others.

No. 442.
Petitions to Parliament for converting Port Nessock Bay into a Harbour of Refuge, 1820.

Petition of the Merchants, Owners, and Masters of Vessels trading from the Port of Irvine, in the County of Ayr, to the Coast of Ireland, and other places, to the House of Commons,

SHEWETH,

THAT your petitioners feel great want of a safe harbour upon the Scotch side of the Irish Channel, where they can run to in bad weather, or in dark nights; that if there were a good harbour, or breakwater, made in the bay of Port Nessock, it would be of the greatest service to the trade of the channel in general, as it is easy of access, and safe to get in or out of; and we consider it the fittest place for a harbour upon the Scotch side, from its being so well marked with headlands, and other advantages.

The undersigned therefore humbly pray that your Honourable House will take their petition into consideration.

ROBERT RANKIN, *Shipowner*, and 56 others.

A similar petition, signed by 29 shipowners and masters, &c., from Troon.

The humble Petition of ANDREW M'DOWALL, Esq., *of Logan, in the County of Wigtown, formerly Representative in three Parliaments for the said County of Wigtown, to the House of Commons,*

SHEWETH,

THAT your petitioner is the proprietor of the lands and barony of Logan, in the said county of Wigtown, and that in the month of May, in the year 1818, he obtained an Act of Parliament for the purpose of enabling him, at his own expense, to erect and establish a harbour within the bay of Port Nessock, situate within the said lands of which he is the proprietor as aforesaid, and he has been ever since employed in carrying such works into execution; and that it is his intention to complete and carry the same into effect, agreeably to the plan submitted to the Committee of this Honourable House, at the time when the said Bill was under their consideration; unless it should appear to this Honourable House, for the reasons hereinafter stated, that it will be for the benefit of the British empire that they should be carried on upon a larger scale, and for more extensive objects than were in his contemplation at the time he applied for and obtained the said Act of Parliament.

That the bay of Port Nessock, as well as that of Portpatrick have both been respectively surveyed by Mr. Telford and Mr. Rennie, civil engineers, as ports of communication between Great Britain and the north of Ireland; that your petitioner has been informed that it has been proposed to Government to expend considerably more than 100,000*l.* in constructing a harbour at Portpatrick, and which, if acceded to, will be expending money most unnecessarily and to great disadvantage, as all seamen who have seen the two places concur in opinion that the bay of Port Nessock is infinitely to be preferred to Portpatrick, which is a rocky inlet without any bay whatever; and your petitioner begs leave to submit to the consideration of the House, that in coming to any conclusion upon the subject, or in determining upon the most proper situation for a harbour on that coast, there are four material objects to be kept in view, viz.:—

1st. Whether Port Nessock or Portpatrick has the better capacity and facility for containing a number of transports, and their convoy sailing with a body of troops, in the event of invasion, or disturbance in Ireland.

2nd. Which of those two places is better suited to serve as a station for the revenue cruisers, and from which they can immediately get into the channel with all winds.

3rd. Which of the two places is situated more advantageously for carrying on a communication with Ireland by packets or other vessels. And

4th. Which of the two places is more likely to afford the better protection to the numerous merchant ships passing the channel in stormy or unsettled weather.

That your petitioner is ready to offer evidence at the bar of this Honourable House that for three of those objects Portpatrick was never intended by nature to be of any use, and that, in your petitioner's opinion, supported by others, competent to form a more correct judgment, no money can make it a harbour of general utility, for that, although the packets of communication, and the small craft may by benefited by the sum proposed to be laid out in the improvement of it, yet, that even to them there would still be insurmountable difficulties and dangers which no sum of money, to be laid out upon it, could by any possibility overcome; inasmuch as owing to its local situation, and from being exposed to one-half of the compass, the entrance to the harbour must of consequence be narrow, or, if not so, no vessel can be safe in it in a westerly gale, nor will they be easy even when narrow; and when blowing hard, with a transverse wind, there will be great risk in entering it among such heavy seas as run in that exposed place. And farther, that in getting out with a westerly wind a vessel must warp off shore, and if she unfortunately miss stays, or a rope get foul in tacking, nothing can save her, as the coast is all precipitous rocks. This was evinced not long since by the loss of one of the packets. For a ship, or square-rigged vessel, it must be the last resource that would make her attempt it, as no commander could, with any degree of safety, run for it in thick or blowing weather, when a lee shore, even if the entrance was safe, for the coast being for many miles so much alike, the situation of the port is easily mistaken, and a vessel would have little chance of weathering the shore if she missed it; added to which several objections to Portpatrick, there is no anchorage for ships off this harbour even in fine weather, as the bottom is rock, and anchorage would be very necessary for transports with troops or their convoy, and also of great use to the revenue cruisers and merchant ships.

That the bay of Port Nessock cannot be objected to for any one of the reasons which have been urged against Portpatrick; it is Plymouth Bay in miniature. The sides of it are rock, and the head of it a sandy beach, and the whole of the bay is excellent anchoring ground in sand and stiff clay, with not a rock or shoal in it, and is constantly made use of at present in fine weather as a place of anchorage, when vessels meet with an adverse tide or a wind off shore. It is naturally sheltered from three-fourths of the compass, and only exposed from S.W. to N.W.; if therefore a breakwater were constructed of about 350 yards, according to a plan to be produced, it will make the best and safest harbour upon any part of the Irish Channel, as there is no other bay so formed for the purpose. There will be 20 feet of water at the ebb of spring tides sufficient to ride fifteen of the largest class of merchant ships, besides many others of lesser size. It will be at all times perfectly easy to get

APPENDIX C.

PORT LOGAN.

No. 442.
Petitions to Parliament for converting Port Nessock Bay into a Harbour of Refuge.

in and out, as from the nature of the bay they are sure of a current on one side or an other in their favour; and although the distance from Dunaghadea is about two miles farther than to Portpatrick, a vessel will run it in as short a period, from the favourable current of the tides; the distance of the first stage towards London, called Glenluce, is four miles shorter than from Portpatrick, being only 15 miles. And farther, that for a place to embark and send a body of troops to Ireland, there could not be a better. They would be enabled to sail together without any obstructions; nor would there be a more desirable harbour for revenue cruisers in any part of Great Britain, as they could be immediately at sea. To Liverpool, and the numerous merchant ships in the Irish Channel, it would be of the greatest service, as it would save many valuable lives and much property, for it is well marked with headlands, and easy of access; for a packet station it would be equally favourable, as they would never be delayed for one moment either in going to, or coming from, Ireland, and should it be considered necessary to ship carriages or other articles, the situation for a pier is particularly convenient.

That by estimates from two operative engineers, the before-mentioned breakwater will not cost more than from 70,000*l.* to 80,000*l.*, and it is generally thought it will not cost so much, from the abundance and facility of getting stone opposite to each end of it.

That your petitioner is so fully convinced of the great utility that such a harbour will be of to the British empire at large, and to Ireland in particular, that he is willing to contribute 30,000*l.* towards the completion of the works upon an enlarged scale. And also (the property round the bay being his own) to afford every assistance in his power towards carrying them into effect.

That a combination of advantages peculiar to the situation of Port Nessock, arising principally from natural causes, and which may be greatly improved by art, and which advantages your petitioner has no hesitation in assuring your Honourable House are not to be found in any other port in the Irish Channel, under the adoption of the plan proposed by your petitioner, is most highly deserving the consideration of this Honourable House not only as an object of great saving to the British empire, but also an object of incalculable advantage to the military and civil government of the country, as well as to all merchant ships passing the channel, and to passengers to and from Ireland by the south-west coast of Scotland.

And your petitioner most humbly prays, for the several reasons hereinbefore in that behalf stated, that this Honourable House will cause a public Bill to be brought in for the purpose of erecting and establishing a port in the bay of Port Nessock, under the management of commissioners to be appointed for that purpose, or in such other ways or means as to this Honourable House shall seem meet, instead of allowing the projected alterations and supposed improvements to be carried on at Portpatrick, which can only be attended with an unnecessary waste of expense to the country, (amounting according to the lowest estimate to upwards of 100,000*l.*,) and be of no public utility whatever.

And your petitioner will ever pray, &c.

Petition of Merchants, Underwriters, Owners, and Masters of Vessels trading from the Port of Liverpool, and others interested in the safe Passage of the Irish Channel,

SHEWETH,

THAT they suffer great risks and losses from there not being a safe harbour upon the Scotch side of the Irish Channel for ships to run to in stromy weather or dark nights.

Your petitioners therefore beg humbly to represent that if a breakwater were made in the bay of Port Nessock, about eight miles north of the Mull of Galloway, it would be the most advantageous place upon that side of the channel for ships to take shelter in, as it is well marked with headlands, easy to get in and out of with all winds, and lies in the tideway of the channel to get north or south, and there is no other place on that side that possesses so many natural advantages.

The undersigned therefore pray that your Honourable House will take their petition into consideration.

Signed by 95 Merchants and Underwriters.

Petition of Masters of Vessels trading to the Port of Liverpool,

SHEWETH,

THAT they suffer great risks and losses from there not being a safe harbour of easy access upon the Sottish side of the Irish Channel for ships to run to in stormy weather or dark nights.

That we are decidedly of opinion that if a breakwater were made in Port Nessock Bay, there is no part of the coast where a harbour can be made with so much advantage to the general shipping interest as at that place, not only for coasters, but also for vessels going out or coming in through the North Channel.

That Portpatrick was never intended by nature as a harbour for general use, because however well acquainted a master may be, he never could with any degree of safety run for that harbour, with thick or bad weather; it has nothing to recommend it, but everything to condemn it, however much may be laid out upon it in the way of improvement; its local situation makes it unsafe and dangerous at all times to enter. Port Nessock, on the contrary, is very different, and by a breakwater will be made an excellent harbour for even the largest description of merchant ships. That port on the one hand, and Belfast on the other, would make that navigation much less dangerous than it now is. Besides, Port Nessock would have that peculiar advantage which neither Belfast nor Loch Ryan has of ships being able to get out of it with almost any wind.

Therefore the undersigned humbly pray that your Honourable House may take their petition into consideration.

Signed by 89 Masters of Vessels of Liverpool and various other Ports.

APPENDIX C.

PORT LOGAN.

No. 442.
Petitions to Parliament for converting Port Nessock Bay into a Harbour of Refuge.

The humble Petition of the several Persons whose Names are hereunto subscribed, being the Merchants, Owners, and Masters of Vessels belonging and trading to Campbelltown, and others interested in the passage of the Irish Channel,

SHEWETH,

THAT a good harbour is much wanted on the Scotch side of the Irish Channel; that Port Nessock is by nature and situation the most favourable place, that if a breakwater were constructed in that bay, ships might with ease and safety take refuge there in the most stormy weather, and darkest night; that no place on that coast is capable of being made such a good harbour, or one which would benefit the revenue and trade in so eminent a degree. The undersigned therefore humbly pray that your Honourable House will take their petition into consideration, and by giving Port Nessock the preference, which it justly merits, grant them a harbour of refuge there, which would be at once most advantageous for Government, and all who navigate, or have property in the Irish Channel; and be the means of saving many valuable lives.

DUN. STEWART, *Provost, Campbelltown,*
and 40 others.

The humble Petition of the Chamber of Commerce of Greenock to the House of Commons,

SHEWETH,

THAT your petitioners feel a lively interest in every measure having for its object the improvement of navigation, and they consider the erection of light-houses, and forming ports of refuge at proper stations in the channel, essential to the preservation of lives and property.

That the coast of Galloway on the west shores of Scotland, extending from the point of Corewal to the Mull of Galloway, is without any inlet where a vessel taken on a lee shore can resort to, for safe anchorage.

That your petitioners have learnt with satisfaction that it is proposed to form a breakwater in Port Nessock Bay on said coast, under the protection of which vessels may be anchored with safety.

That with regard to the conveyance of the mail betwixt Britain and Ireland, your petitioners are of opinion the establishing of a post-office at Port Nessock would be of advantage, as, with certain directions of wind, that port may be approached and departed from when it is impracticable at Portpatrick.

That a general tonnage on shipping towards the attainment of the above object would be unjust, but in the event of such breakwater being formed, the trade here would cheerfully pay a fair rate of harbour dues for its use, at all times when their shipping may resort to it.

Your petitioners humbly beg your Honourable House may give its support to have the bay of Port Nessock rendered a safe resort for shipping.

And your petitioners will ever pray, &c.

ARCHIBALD WILSON, *Chairman.*

Greenock, May 12, 1820.

No. 443.

Report by JOHN LINN, Esq., *on the means of improving Port Logan Harbour.*

No. 443.
Linn, on the means of improving Port Logan Harbour.

SIR,

Portpatrick, December 22, 1840.

YOU will receive herewith plan and sections for Port Logan harbour, which I trust will meet the Colonel's approbation.

I have shown upon the plan, in a red tint, the proposed repairs which may be executed in a substantial manner for about 480*l.* The yellow tint denotes the stones or rather beach accumulated at the pier-head, which may be removed so as to give 8 feet at low water of spring tides for about 200*l.* On the sections Nos. 1, 2, and 3, the yellow tint denotes the land which ought to be removed in order to make the harbour accessible at all times of tide; but having an opinion that the harbour will not maintain its depth if deepened, without the aid of scouring, and there being no springs in the adjoining lands capable of producing an adequate supply of water for that purpose during the summer, I would strongly recommend that a sluice be made through the pier where the breach is, the opening to be an ellipsis 8 feet wide by 6 feet in height, the sill to be laid at low-water mark in spring tides, and to have a sufficient door mounted with proper draw gear, to open and shut occasionally, as circumstances may require.

I have given the subject my best consideration, and I am decidedly of opinion that a sluice through the pier will answer an excellent purpose, and the action of the waves in time of strong breezes will give at least 3 feet of rise and fall through the sluice, which must in a great measure, if not entirely, remedy the evil.

I am, &c.,
JOHN LINN.

James M'Neil, Esq.

No. 444.

Return of Income and Expenditure for the Years 1841–2–3.

No. 444.
Income and Expenditure.

INCOME.										EXPENDITURE.									
Heads of Income.	1841			1842			1843			Heads of Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Tonnage and anchorage dues .	33	0	0	47	2	8	43	16	8	Harbour-master's salary	11	0	0	11	0	0	11	0	0

Dues levied under authority of Act 58 Geo. III.

JOHN SEMPLE, *Comptroller.*

APPENDIX C.

PORT WILLIAM.

No. 445.
Return to Order of the House of Commons of 9th Aug. 1844.

PORT WILLIAM.

No. 445.

Return to Order of the House of Commons of August 9, 1844.

Harbour Office, Port William, February 8, 1845.

1st. Report by Robertson Buchanan, civil engineer, dated 18th April, 1812.

2nd. Plan of the harbour as proposed to be improved, by Robertson Buchanan, civil engineer, 20th April, 1812.

3rd. Elevations and sections by Robertson Buchanan, civil engineer, 21st April 1812.

4th. Plan, elevations, and sections by John Linn, engineer of the Portpatrick harbour, 13th November 1841.

5th. Specification by John Linn, engineer of the Portpatrick harbour, 13th November 1841.

6th. Letter by John Linn, engineer of the Portpatrick harbour, to Mr. Cumming, factor to Sir William Maxwell, Baronet, dated 13th November 1841, containing estimate of expense.

7th. Letter by John Linn, engineer of the Portpatrick harbour, to Mr. Cumming, factor to Sir William Maxwell, Baronet, dated 19th November 1841, containing additional estimate.

8th. Plan by Captain Robinson, R.N., when surveying the Bay of Luce, 1839–1840.

POWTON JONES, *Harbour-Master.*

No. 446.

Report of ROBERTSON BUCHANAN, Esq., C.E., *on the state of the Harbour, and proposals for Improvement.*

No. 446.
Buchanan, on the state of the Harbour and proposed Improvements.

Glasgow, April 18, 1812.

I. AT the request of Sir William Maxwell, Baronet, of Monrieth, having on the 6th of April visited the harbour of Port William, I found the quay, jetty, and other interior parts in good order, but rendered useless by being obstructed by a large quantity of shifting beach or gravel which had been driven across its mouth in consequence of the failure of a breakwater which had extended from the end of the quay toward the beacon.

This breakwater seems to have been built to answer the double purpose of protecting the mouth of the harbour from the heavy sea which often sets in from the mouth of the bay of Luce, and to retard the shifting beach or gravel, large quantities of which in certain winds are driven by the sea along the shore, and naturally tend to obstruct the harbour.

I also found that the burn of Port William, which originally ran into the harbour, had been turned into a new channel in order to send it into the sea without passing through the harbour. This alteration, I was informed, was made with a view to prevent the gravel which the burn brought down its channel from being lodged in the harbour, as also to prevent the stream from undermining the quay-wall at the upper end, which it had frequently done, owing to its great fall and rapid current at that place. From this change of the channel, however, a great evil had arisen; for, not having been sufficiently protected at the mouth against the action of the waves, a large quantity of ground had been washed away, and thus contributed to increase the shifting beach, which, as already mentioned, was one of the greatest detriments to the harbour.

I was further informed that, during the period which the breakwater stood, the harbour had been found perfectly tranquil, kept free from obstruction at the mouth, and had been highly useful not only to the trade of this part of the country, but in giving protection during storms to many vessels belonging to other ports.

The depth of water at the quay was usually about 12 feet at spring-tides, and 7½ at neap-tides. There is a considerable fall from the bottom of the quay to low-water mark, which is about 100 feet beyond the beacon.

II. Upon these facts I take leave to offer the following observations:—

1. Had the burn been allowed to remain in its original channel, it appears to me that a moderate sum expended on that part of it which is between the milldam and the harbour, in forming and defending its banks and bed, would have prevented it from bringing down any gravel that could have been injurious; and by building a proper cascade at the upper end of the harbour, the force of the stream would have been destroyed, so as to prevent it from undermining the quay-walls; and that with these precautions the burn might have been rather beneficial in keeping the harbour clear. During floods at low-water, its current might have been strong enough to operate in some degree upon the shifting beach. It is well known that to procure the advantage of a backwater to a harbour great expense has in some cases been incurred.

But the new channel having been formed, it may be well for those immediately in the management of the harbour to consider whether it would on the whole be more prudent to use the new or the old channel. It is one thing to advise a work to be made, and another to advise its demolition when made. In case the new channel be adopted, it will be proper to break the force of the current by cascades, in order to prevent it from tearing up its bed.

2. It seems to me that the breakwater was objectionable, not only from *not having been constructed of proper materials*, but also from its *direction*. Its direction was indeed such as would *for a time* have prevented the beach from getting round its outer extremity, but, as soon as it should have been filled up in the angle, the beach would have been washed round its head.

It was, I apprehend, objectionable on another account, namely, that it was nearly at right angles to any heavy sea which might set in from the mouth of the bay, in which direction it would receive a greater shock from the waves than if they had struck it in a more oblique direction.

It was further objectionable by widening the mouth of the harbour to receive the sea necessarily when the winds were from the bottom of the bay.

III. For these reasons I would propose making a new pier in a direction somewhat different from the breakwater, viz. curving toward the shore until its head should fall within a line bearing upon the mull of Synness. This direction of the pier I am of opinion would be attended with the following beneficial effects:—

APPENDIX C.

PORT WILLIAM.

No. 446.
Buchanan, on the state of the Harbour and proposed Improvements.

1. From falling within the line mentioned above, the harbour would be much better protected from the sea when the wind should blow from the bottom of the bay, while its curving form, convex toward the sea, would give it strength; and the heaviest seas from the mouth of the bay would strike it in a more oblique direction, and consequently with diminished force. Upon re-examining the ground, however, it may be found proper to deviate a little from the particular curve and direction of the pier specified on the plan, and in the progress of the work outward, which must be gradual, a better judgment will be formed how the remainder of it should be directed.

With regard to the action of the sea on the shifting beach in all possible cases, it is difficult to determine, and it would require more observation on the action of the waves, tides, and currents at Port William than I have yet had an opportunity of making, to speak on this subject with certainty. But were the pier made in the form and direction laid down on the accompanying plan, it seems highly probable that the action of the sea from the bottom of the bay would serve so far to counteract the action of the sea from its mouth as to prevent the beach from getting round the pier-head into the harbour, and that there would be a shifting bank on the outside of the pier inclining outward and inward accordingly as the winds might be, but keeping generally nearest the outward extremity.

IV. With regard to the *extent* of the proposed pier, much must depend upon the funds appropriated to the improvement of the harbour. But, provided these be sufficiently ample, I would recommend building a pier at least 100 feet longer than the former breakwater, having sufficient breadth of roadway and height of parapet to admit of persons giving the necessary assistance to vessels in stormy weather either in entering or leaving the harbour; and in case of the increase of the trade, which would be a natural consequence of this improvement, another head could be extended from the land farther out than the present jetty, and thus, at little additional expense, greatly enlarge the harbour and allow the admission of vessels of greater draft of water. It might, I apprehend, when necessary, be further enlarged by building quay-walls along the shore from this head inward.

The accompanying drawings and specification will explain the details of the construction of this pier. I may, however, mention that the courses of stones dipping at an angle of forty-five degrees not only gives great facility in building, but also, from their oblique direction to the action of the sea, lessens its power of lifting the stones from their places. The walls are intended to be built without cement, and the outer wall to be made as rough on the outside and as open (in the end joints particularly) as practicable, in order that the sea may be allowed to work through them, to soften its action, in a manner somewhat similar to a hedge in softening the action of the winds.

But should a pier of such length be thought too expensive, it might be executed on the same plan as far out as to be opposite the beacon, to be afterwards extended as circumstances might permit.

ROBERTSON BUCHANAN.

No. 447.

Specification, by JOHN LINN, Esq., C.E., *of the mode of constructing the proposed Pier of Port William Harbour, and Estimates.*

No. 447.
Linn, on the mode of constructing proposed Pier.

Portpatrick, Nov. 13, 1841.

THE whole of the several works connected with the above are to be executed agreeably to this specification and the accompanying drawings, so that upon their completion the pier may be left perfect in every respect.

The red tint on plan denotes the proposed pier, to terminate at, and finish with a circular head 14 feet on the outside of the perch.

When the present rubble wall shall have been removed, the foundations of the inner and outer walls and pier-head are to be excavated to the depth of 6 inches below low-water of spring tides at the toe, and to dip in form as shown in the section, with the exception of about 120 feet of the outer wall foundation next the land, which is to rise up in steps of not less than 12 feet each step, and to be well united to the solid clay within the beach. When the foundations shall have been properly prepared, a course of flat stones 1 foot thick, averaging not less than a ton each, which must be all headers, hammer-dressed on the beds and joints, are to be laid and bedded solidly into the clay below.

The exterior and interior faces of the walls and pier-head are to have a circular batter, and at the level of the pavement, or 6 feet above high-water mark of spring tides, the pier-head shall measure 32 feet diameter from out to out, and the pier at A B is to measure 26 feet wide at the same level, leaving a clear carriage-way 20½ feet within the parapet.

The whole of the facing of the inner and outer walls, pier-head, and parapet is to be composed of the best whinstone from the Garrarie quarries, pick and hammer-dressed, and to be set in regular courses from 9 to 18 inches thick, with a header for every three stretchers, s
less in width than one and a half its thickness, and no header to be less i
twice and a half its thickness, and no stone in the facing of the walls t
inches.

Cross-walls 9 feet thick are to be brought up in the interior of the pier, [illegible] apart, and well connected to the exterior walls: the intermediate space between the cross-walls are to be filled up with whinstone rubble, set upon edge, and the joints run full of sharp sand and gravel to be taken from the beach.

The courses from high-water mark to the top bed of the coping are to be set in mortar and solidly grouted. The inner wall is to be coped with neatly pick-dressed whinstone, averaging 3 feet in width on the bed, and from 12 to 18 inches thick, and no stone to be less than 3 feet in length on the face.

The whole of the hearting of the pier from high-water to the under bed of the pavement is to be composed of whinstone rubble, set upon edge or lengthwise, and solidly grouted in with concrete mortar, composed of 3 parts of clean gravel, 2 of sharp sand, and 1 of quick lime.

The whole surface of the pier, between the inner and outer walls, is to be neatly paved with whinstone rubble, set on edge and solidly grouted, or properly Macadamized with whinstone broken small, so that no piece shall contain more than two cube inches, and to be 9 inches deep of the above materials, and to be well grouted.

APPENDIX C.

PORT WILLIAM.

No. 447.
Linn, on the mode of constructing proposed Pier.

The whole of the parapet is to be neatly hammer-dressed, and set in regular courses, as shown in the sections.

The stair, shown in the face of the inner wall of the pier, is to consist of 28 steps, 3 feet long, 12 inches broad, and 8 inches thick, and neatly pick-dressed.

The whole of the facing of the walls of the pier above high-water mark, and the parapet, are to be set and grouted with mortar, composed of 1 part of the best Anglesea and Isle of Man lime, half part Italian pozzolana, and from 2 to 3 parts of clean sharp sand; the backing is to be set in mortar, composed of 1 part of Isle of Man lime and 3 parts of clean sharp sand.

The whole of the labour, materials, and workmanship are to be the best of their respective kinds, and to be executed in the most substantial and workmanlike manner, and to the entire satisfaction of the engineer, who shall have full power and be at liberty to reject all materials or workmanship that may appear improper or insufficient, and compel the contractor to replace and make good the same at his own cost.

The contractor is to furnish all labour and materials, and all tools and machinery of every description, required to carry on and complete the above works; and to take upon himself the risk of all accidents that may occur to the works during their execution.

JOHN LINN.

No. 448.
Revenue and Expenditure.

No. 448.

Return of Income and Expenditure for the Years 1842–3–4.

INCOME.										EXPENDITURE.									
Heads of Income.	1842			1843			1844			Heads of Expenditure.	1842			1843			1844		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*		£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
Tonnage dues at 2*d.* per ton . . .	46	14	10	45	18	2	50	13	6	Rebuilding quay walls, &c.	22	19	10¾	22	19	10¾	22	19	10¾
Dues on goods . .	77	17	2	77	4	7	75	2	8½	Repairs and crane .	37	8	9	37	8	9	37	8	9
										Clearing out harbour	38	9	8½	38	9	8½	38	9	8½
Total . . £	124	12	0	123	2	9	125	16	2½	Total . . £	98	18	4	98	18	4	98	18	4

The harbour was built by subscription of the proprietor and his tenants, by whom the dues were fixed, and which are cheerfully paid by persons using the harbour.

The amount of expenditure of each year cannot be stated; the average of the three years has therefore been given.

JAMES CUMMING, *Factor to the Proprietor.*

WHITHORN.

No. 449.
Return to Order of the House of Commons, of the 9th August, 1844.

WHITHORN.

No. 449.

Return to Order of the House of Commons of August 9, 1844.

Whithorn, February 13, 1845.

THE port or harbour at isle of Whithorn belongs to the corporation of the burgh of Whithorn, by Charter granted by James IV. of Scotland, under which Charter they act as proprietors and managers of the said harbour.

The port or harbour at isle of Whithorn has never to the Reporter's knowledge been visited by any Government engineers, or other officers; and, consequently, no maps or plans have ever been furnished them, nor are they in possession of any reports or complaints by any Government commissioners.

Reported by
JOHN BROADFOOT, *Provost.*

No. 450.
Revenue and Expenditure.

No. 450.

Return of Income and Expenditure for the Years 1841–2–3.

INCOME.										EXPENDITURE.									
Heads of Income.	1841			1842			1843			Heads of Expenditure.	1841			1842			1843		
	£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*		£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*
Harbour and anchorage dues . . .	117	0	0	119	0	0	113	0	0	Repairs and improvement of harbour .	14	10	0	32	7	1	68	12	5

The dues are levied under the Charter of King James of Scotland, and ratified in 1662.

JOHN BROADFOOT, *Provost.*

GARLIESTOWN.

No. 451.

Return to Order of the House of Commons of August 9, 1844.

No. 451. Return to Order of the House of Commons, of the 9th August, 1844.

SIR, *Garlieston, March* 11, 1845.

IN reply to your letter of the 1st ultimo, we beg to state that we have no titles or Charter for the harbour of Garlieston, the port having been built by voluntary subscription, and the very moderate dues levied thereon are submitted to by mutual consent; neither was there any map even made of the same till now. We have got Mr. John Christison, land surveyor here, to furnish the enclosed for the information of the commissioners. Our port, so far as we know, was never surveyed by any Government engineer, and consequently we cannot point out any defect from that source. Only one may again say that were 800*l*. sterling further expended on our new breakwater, the Cumberland colliers and other strange vessels would be enabled to avail themselves of the shelter *earlier in the tide*, whereby many useful lives and much valuable property in all likelihood would be saved.

We have, &c.,
JOHN STUART,
JAMES WALDIE,
JAMES BRYCE,
JOHN POLLOCK.

The Hon. H. Manners Sutton.

P.S.—May we beg of you to give orders to return the plan as we have no copy of it.

JAMES WALDIE,
For Self and other Members of the Committee.

No. 452.

Return of Income and Expenditure for the Years 1841–2–3.

No. 452. Revenue and Expenditure.

INCOME.

Heads of Income.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Custom and anchorage dues . . .	111	0	0	94	0	0	99	0	0
Subscriptions . .	3	3	0	1	1	0	1	1	0
Interest on bank deposit	2	8	7	1	19	0	1	5	1
Loan	..			..			300	0	0
Total . . £	116	11	7	97	0	0	401	6	1

EXPENDITURE.

Heads of Expenditure.	1841			1842			1843		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Clerk and auctioneer	2	1	0	2	1	0	2	1	0
Repairs and extending harbour and breakwater	33	12	0	261	14	1	410	3	0
Weighing-house and wood-green . .	1	3	6	0	2	6	0	2	6
Expense of meetings	4	2	2	3	0	2	3	8	11
Interest . . .	14	2	6	14	10	0	23	4	2
Total . . . £	55	1	2	281	7	9	438	19	7

The dues are paid by mutual consent.
All vessels entering the harbour pay for each voyage 1*d*. per ton register.
The harbour was built by subscription, at a cost of 2,600*l*.

JOHN STUART.
DAVID RODGER.
JAMES WALDIE.
JAMES BRYCE.
JOHN POLLOCK.

Debt due on the 1st of January, 1846, 555*l*.

BALDOON.

No. 453.

Return to Address of the House of Commons of July 29, 1844.

No. 453. Return to Address of the House of Commons, of the 29th July, 1844.

Receipt.

	£	s.	d.
Dues collected, 2*d*. per ton register.			
From 2nd May to 17th Nov., 1842 .	7	17	10
(No dues collected previous to first date.)			
From 17th Nov. 1842, to 22nd Dec. 1843	8	5	10
From 22nd Dec. 1843, to 22nd Nov. 1844	12	17	0
Total . .	£27	0	10

Expenditure.

				£	s.	d.
Expense of Collection				0	17	10
Ditto ditto	£	16	10	28	19	2
Repairing Roads to Harbour	28	2	4			
Expense of Collection .	£	17	2	22	10	2
Improving Quay . . .	21	13	0			
Total . . .				£52	7	2

These dues are collected by authority of the Earl of Galloway. The quay, and roads leading to the same from the public road, are on his Lordship's private property.

The above humbly reported by

JOHN M'MILLAN, *Agent for the Earl of Galloway.*

Newton Stewart, November 27, 1844.

APPENDIX C.

BARLOCHAN.

No. 454.
Return to Address of the House of Commons, of the 29th July, 1844.

BARLOCHAN.

No. 454.

Return to Address of the House of Commons of July 29, 1844.

SIR, *Barlochan, July 22, 1843.*

IN reply to yours of the 18th instant, I beg to say that there is no harbour master at this port, nor are there any dues collected; every master of a vessel does as he pleases, and on that account we have many disturbances here about bulks.

I remain, &c.,
GEORGE M'ADAM, *P.C.O.*

The Hon. H. Manners Sutton.

CARTY.

No. 455.
Return to Address of the House of Commons, of the 29th July, 1844.

CARTY.

No. 455.

Return to Address of the House of Commons of July 29, 1844.

Receipt.	£.	*s.*	*d.*	*Expenditure.*	£.	*s.*	*d.*
Dues collected, 2*d.* per ton register.				1842. Repairing Quay	2	2	0
Year to 22nd November, 1842 .	16	17	4	1843. Expense of collecting Dues .	0	10	0
Ditto ditto 1843 .	15	9	10	1844.	–	–	–
Ditto ditto 1844 .	18	3	10				
	50	11	0		2	12	0

These dues are collected by authority of the Earl of Galloway. The quay, and road leading to the same from the public road, are on his Lordship's private property.

JOHN M'MILLAN, *Agent for the Earl of Galloway.*

Newton Stewart, November 27, 1844.

Note—There is an old *public* landing-place or port of Carty a little higher up the Creek, which is now in disuse.

WIGTOWN.

No. 456.
Return to Order of the House of Commons, of the 9th August, 1844.

WIGTOWN.

No. 456.

Return to Order of the House of Commons of August 9, 1844.

SIR, *Wigtown, March 28, 1845.*

I HAVE the honour to aknowledge your circular letter of the 1st February last, and to state that—

1st. The magistrates and council of the burgh having acquired right to the site of the present harbour, built and completed the works now in use, at the cost and charge of the burgh, and continue to keep the port or harbour and landing-places in the river Bladnoch in good order and repair; and the magistrates and council, to repay the cost of building and keeping up the said harbour, levy the rates and dues mentioned in the return formerly made. There is no local or other Act of Parliament relating to the harbour.

2nd. There is no special Charter or Commission to the harbour except a writing, recognising the burgh's right to the port and harbour ground from the Earl of Galloway, the proprietor of the adjacent lands.

3rd. There are no maps of the harbour or port in the possession of the magistrates and council, and they are not aware of there being any in existence.

4th. There are no reports by engineers or other officers respecting the harbour, so far as the magistrates and council know.

5th. The magistrates and council do not recollect any particular complaints being made to them regarding the harbour, and they are not in possession of any written complaints made to them of the defects of the harbour.

I have, &c.,
GEORGE M'HAFFIE, *Provost.*

The Hon. H. Manners Sutton.

No. 457.
Revenue and Expenditure.

No. 457.

Return of Income and Expenditure for the Years 1841–2, 1842-3, 1843-4.

INCOME.				EXPENDITURE.			
Heads of Income.	1841–2	1842-3	1843-4	Heads of Expenditure.	1841–2	1842-3	1843-4
	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*		£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*
Harbour dues . .	40 5 0	45 10 0	55 5 0	Improvements and other expenses .	5 14 10	47 16 4	4 0 0
				Repairs	1 10 3	2 1 7	16 11 4½
				Total . . £	7 5 1	49 17 11	20 11 4½

The dues are levied under the authority of the Magistrates and Town Council.

WM. CARRON, *Town Clerk.*

GATEHOUSE.

No. 458.
Return to Order of the House of Commons, of the 9th August, 1844.

GATEHOUSE.

No. 458.

Return to Order of the House of Commons of August 9, 1844.

Titles of the several Acts of Parliament, and Charters and Commissions under which they have acted or now Act.	Copies of Maps of the Harbour.	Reports by Engineers, or other Officers.	Copies of any Complaints made to Commissioners, &c.
No Commissioners or other persons act under any Act of Parliament, or Charter or Commission, but the dues are collected by a private individual, with consent of the Superior and magistrates of Gatehouse.	None.	None.	None.

Gatehouse, February 3, 1845.

DAVID M'ADAM, *Harbour Master.*

No. 459.
Revenue and Expenditure.

No. 459.

Return of Income and Expenditure for the Years 1841–2–3.

INCOME.				EXPENDITURE.			
Heads of Income.	1841	1842	1843	Heads of Expenditure.	1841	1842	1843
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Harbour dues . .	22 1 6	28 3 10	29 4 5	Repairs	2 17 2	1 12 0	3 0 5
Beacon or perches dues	4 16 1	5 0 9	4 13 8	Moorings and chain	0 4 9	1 8 8	..
				Cleaning harbour .	1 15 6	1 9 0	2 2 6
Total . . £	26 17 7	33 4 7	33 18 1	Total . . .	4 17 5	4 9 8	5 2 11

Private harbour belonging to Mr. D. M'Adam. Dues levied by the authorities of the burgh.

D. M'ADAM, *Harbour Master.*

KIRCUDBRIGHT.

No. 460.
Return to Order of the House of Commons, of the 9th August, 1844.

KIRKCUDBRIGHT.

No. 460.

Return to Order of the House of Commons of August 9, 1844.

Kirkcudbright, February 24, 1845.

1st. THERE is no Act of Parliament, Charter, or Commission regulating the harbour of Kirkcudbright.

2nd. There are no maps of the said harbour in the possession of the magistrates and council.

3rd. There are no reports of engineers or other officers respecting the port in their possession.

4th. There are no complaints of the harbour in their possession.

WILLIAM MARSHALL, *Chamberlain.*

No. 461.
Revenue and Expenditure.

No. 461.

Return of Income and Expenditure for the Years 1842–3–4.

INCOME.				EXPENDITURE.			
Heads of Income.	1842	1843	1844	Heads of Expenditure.	1842	1843	1844
	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.
Harbour dues . .	38 16 8	74 18 0	84 19 4	Repairs and new works	16 5 0	31 5 6	8 16 0
Anchorage dues . .	1 10 0	3 10 0	4 5 0	Cleaning out dock .	7 2 0	10 4 6	7 18 10
Total . . £	40 6 8	78 8 0	89 4 4	Total . . £	23 7 0	41 10 0	16 14 10

The dues are levied under the Charter of James II. of Scotland [1455], confirmed by Act of Charles I. [1633].

W. MARSHALL, *Chamberlain.*

DUMFRIES.

No. 462.
Return to Order of the House of Commons, of the 9th August, 1844.

No. 462.

Return to Order of the House of Commons of August 9, 1844.

1. The title of the Act of Parliament under which a tonnage on the shipping of the river Nith is levied, and under which Commissioners are appointed and act, is "An Act for improving the Harbour of Dumfries and the Navigation of the River Nith." This Act was passed in the year 1811.

2. A copy map of the river Nith by James Hollinsworth, civil engineer, referred to in the said Act, is now sent.

3. A copy of the engineer's report on improvements of the river Nith and its harbours, by said James Hollinsworth, is now sent.

4. There have been no complaints made to the commissioners of the defects of the navigation of the Nith and harbour of Dumfries, since the passing of the aforesaid Act, which was intended to remedy them.

K. Kneskie, *Clerk and Treasurer of the Nith Navigation.*

No. 463.

Report by James Hollinsworth, Esq., C.E., *on the present State and proposed Improvements of the River Nith.*

No. 463.
Hollinsworth, on the present State and proposed Improvement of the River Nith.

Dumfries, July 21, 1810.

Having carefully surveyed the river Nith from Dumfries to a little below Glencaple quay, and examined various respectable and intelligent persons, well acquainted with the nature and navigation of the river; it appears to me that considerable improvements may be made, for the convenience and safety of vessels navigating the river, as well as for reducing the expense of land carriage, in carting coal, goods, and other commodities imported and exported by means of the said river.

It appears that the place originally used for shipping and landing cargoes for Dumfries and the adjacent country, was at Gleneaple quay, distant from Dumfries about five miles; but from the bed of the channel, below that place, being of a soft moveable sand, and from the general flow of the tide, first striking on a projecting point of land on the eastern or Dumfries side, called Olenhowan Scar: it has been forced in a north-westerly direction, to the western shore, near Kirkconnell, by which it has formed a channel along that shore and cut away the merse for a considerable extent; then crossing over to the Dumfries side a little above Glencaple quay, it leaves an extensive sandbank, which prevents vessels from coming to or near to that quay. In consequence of this, vessels have been under the necessity of shipping and landing their cargoes at Kelton, distant from Dumfries about three miles and a half, where there is no other accommodation than the bare beach. At this place the average spring tides flow about 12 feet.

From this place upwards, there are various obstructions in the river; such as shoals, sharp turnings, and windings, which render it very difficult for vessels to navigate with safety.

There has of late been a quay or rather a dock, erected near Kingholm, distant from Dumfries about a mile and a half. This quay or dock, from its situation and construction, does not promise to be of much utility, either for safety or convenience; there is so much moveable sand and silt in the river, that a few tides fill up the dock, so as to prevent vessels entering: although there is a small reservoir and sluice, they do not appear adequate for the purpose of clearing out the dock. The average spring tides flow at this place about 9½ feet.

From this place towards Dumfries, the river becomes more shallow, particularly at Kingholm, a little above where there appears sometime to have been a place for landing and shipping. At this place there appears to have been both great labour and expense to force the river out of its natural course, apparently for the purpose of either saving or procuring a small piece of land, of but very little value.

A little above this, there is a rock lying above the bed of the river, which contracts the passage, and renders it dangerous for vessels to pass.

In consequence of this, and the shallow place before mentioned, the rise of the river is so much, that the average spring tides do not flow more than about 6 feet, opposite to a piece of ground, called the Dock, near Dumfries.

From the shallowness of the river here, and the obstructions immediately below, and the very few successive tides that flow 6 feet at this place, it is seldom that vessels, even of a small draft of water, will venture so far up, from fear either of damage or of being detained from want of water.

Having thus far pointed out the principal obstructions, I shall now endeavour to point out the best mode either of avoiding or removing them.

Referring to that part of the river which lies below and opposite to Glencaple quay, where the prevailing current of the tide has carried the channel out of its direct course, and destroyed so much merse land, the proprietor of Kirkconnell, whose lands it has so much injured, has begun a work that, if persevered in, I have no doubt, will soon restore the channel to its proper course.

This work is the forming of an extensive quay or jetty on the Kirkconnell shore, at a place where there had originally been one, and no doubt for the same purpose; but it has been allowed to lose its effects, from the want of being properly attended to. It had originally been carried out about 110 yards from high-water mark, to which extent the proprietor proposes to renew it; were this to be extended out about 50 yards farther, and the whole raised to a proper height, I have no doubt but it would effectually secure the channel in a proper direction, as well as be a protection to the merse; and by the laying up of the sand it would in time regain a great part of what has been formerly lost; this would again open the navigation to Glencaple quay, and from thence to Kelton there is little or no obstruction.

From Kelton to Dumfries, as before stated, there are many obstructions; the most safe and permanent remedy for these would be a canal from Kelton to a piece of ground near Dumfries called the Dock. The shore is well adapted for a canal; but there does not appear to be a sufficient supply of

No. 463.
Hollinsworth, on the present State and proposed Improvement of the River Nith.

water in dry seasons, without taking the water from the mills near Dumfries, which would render them useless; and from the great quantity of sand and silt that comes up with the tide, the canal would require to be supplied without having any recourse to the tide water, otherwise it would soon fill up. It also appears to be the general idea of those concerned, that the funds of the river would not be adequate to the expense of a canal, which, it is supposed, would cost from 18,000*l.* to 20,000*l.*

Under these circumstances, the only alternative will be that of improving the course of the river, on the best and most economical plan, which may be done in a gradual way as the funds accumulate, by first removing such obstructions as most materially interfere with the navigation of the river.

The first object would be to cut off the turns, as described on the plan. It certainly would have been a more desirable course to have cut through Netherwood merse, as described by the blue lines, but to this there appears to be a strong objection, the merse being embanked from the river, the land is of great value. I therefore propose to take the direction marked by the red lines.

After cutting through the turns at Netherwood merse, and the one at Kingholm, and the channel properly confined to the new cuts, by putting jetties across the present channel, I should recommend the whole course of the river to be contracted by jetties and embankments, to a regular course, nearly as described by the red lines on the plan.

By being thus contracted, the greater part, if not the whole, of the bed of the river, south of Castledykes, would at all times be kept clear, and at the time of great floods in the river, would considerably increase its depth: should any banks remain in the bottom, they may readily be removed by dredging or loosening them.

As there is a fall from Castledykes to the new quay of about $3\frac{1}{2}$ feet, by cutting through the turn at Kingholm, and deepening it as before described, it would give an opportunity of coming at the rock which now lies above low water, and appears to be of a quality not very difficult to remove.

On the eastern side, at Castledykes, there is a shelf of rock that runs along under the side of the road, at about the level of low water. I would recommend a breast to be built along the outer edge of this of rough stone, and to fill it up behind either with earth or rubbish, to above high-water mark; then by cutting off a little of the turn on the opposite side, as described on the plan, it would give an easy and gradual curve to the course of the river; from this there will be no difficulty in deepening up to, and along the side of, the dock.

But there will be required a new strong wall to be built along the side of the dock where vessels are to lie, as the present wall is not founded sufficiently deep, nor does it appear to have been built for any other purpose than for the protection of the ground.

Now, admitting that the river is not at all lowered at Kelton, there is a rise from thence to the new quay of $2\frac{1}{2}$ feet, which, being lowered only 1 foot, leaves a fall of $1\frac{1}{2}$ foot. There is then a rise of $3\frac{1}{2}$ feet from the new quay to the dock, which, being lowered $2\frac{1}{2}$ feet, leaves a fall of 1 foot to the new quay; this makes $8\frac{1}{2}$ feet of tide water at the dock at average spring tides, and 2 feet of ordinary fresh water makes $10\frac{1}{2}$ *feet of water* at average spring tides. Then admitting the increase of tides, before the height of the springs, and the decrease for the same time after in an average tide, there is every reason to believe that there will be 9 feet water at the dock, *for four or five days* at every spring tide, without depending upon either extraordinary tides or freshes.

It appears from the best information that there are few or no vessels trading or belonging to the port of Dumfries that draw more than from 7 to 8 feet water. For these there will be, by the means before stated, always sufficient water for several days every spring tide.

And admitting that these propositions are carried into effect, and the straightening and contraction of the river strictly persevered in, I have no doubt but in time a much greater depth of water may be obtained.

From the nearest calculation I am able to make, it appears to me that the expense of executing the various works as before described, will cost the sum of 5,200*l.* sterling.

JAMES HOLLINSWORTH, *Civil Engineer.*

Alexander Maxwell, Esq.

No. 464.

Memoranda by WALTER NEWALL, ESQ., C.E., *relative to the Navigation and Improvement of the River Nith, from Dumfries to the Sea.* 1812.

No. 464.
Newall, on the Improvement of the Nith.

PREVIOUS to 1810 the navigation of the river Nith had become very dangerous, even for small vessels, and quite impassable, above Kelton, for vessels above sixty tons burthen, except in high spring tides. Consequently the merchants and shipowners of Dumfries resolved to apply to Parliament for powers to commit the management of improving the river to commissioners, to be appointed by Parliament, and also for power to levy duty upon the tonnage of the shipping, and upon goods imported and exported into, and out of, the port of Dumfries, for the purpose of raising funds to enable these Commissioners to improve the navigation of the river and the harbours therein.

In order to ascertain the extent to which the Nith was susceptible of improvement, application was made to the late Mr. Rennie to survey the river, and to give his opinion as to the proper mode of proceeding to accomplish that desirable object; he, therefore, sent Mr. James Hollinsworth to survey the river, and to report as to its present state, and the best mode of improving its navigation, and also to make out an estimate of the expenses of his proposed improvement.—[See No. 463.]

Mr. Hollinsworth no doubt obtained the best information that he could regarding the practicability of improving the river Nith, but it is deeply to be regretted that such limited views were entertained by him regarding these improvements as he has embodied in his report; and that such circumscribed powers were obtained to carry such limited improvements into effect. Mr. Hollinsworth contemplated no improvements below Kirkconnel jetty, consequently, the power obtained for improving the navigation of the Nith, extended only from "Assembly-street, Dumfries, to the jetty at Kirkconnel, by Glencaple; and through that distance the depth is not to be less than six feet in neap tides, when the same is practicable." Powers should have been obtained to extend the improvement of so important a navigation as that of the Nith and Solway, as far southwards as to obtain a low-water navigation from Dumfries to the Irish sea, which is quite practicable, and that, too, without the semblance of a bar in any part of the channel throughout that distance, which will appear from the sequel of the following memoranda.

At a meeting of Commissioners upon the 29th August, 1811, I was appointed engineer to conduct the improvements of the navigation of the Nith, and at the same meeting I was instructed to ascertain

APPENDIX C.

DUMFRIES.

No. 464.
Newall, on the Improvement of the Nith.

the true state of the declivity of the low-water channel of the river from Dumfries to Glencaple quay, and to lay down the lines of the portions of new channel that were to be formed through the lands of Kingholm and Netherton, in order that estimates could be obtained of the expenses of forming these new portions of the channel. In compliance with these instructions I ascertained that the declivity of the surface of the river, from Dumfries to Glencaple quay, was nine feet nine inches, and that the distance by the channel was five and a half miles from Assembly-street. With the view to laying down the portions of new channel that were to be formed through the merses of Kingholm and Netherton, I carefully examined the old channel, and compared it with the plans that were surveyed previous to obtaining the Act of Parliament for improving the navigation of the Nith, and also with a plan that was surveyed under the directions of Mr. Robertson Buchanan, C.E., after the Act was obtained, but I found that all these plans were very inaccurate; and that the lines for the proposed new channel were laid down in such a manner, that the river could not be improved, even to the limited extent that was proposed, without involving a very unjustifiable outlay. I, therefore, found it absolutely requisite that the whole of the river should be re-surveyed, and an accurate chart of it projected, in order that the line of the new channel could be accurately laid down upon it. Consequently, I lost no time in surveying the river from Dumfries to Greenmerse point, and laid down an accurate chart of the channel throughout that distance; upon which I laid down the new line for the improved channel, in order that the works required to form the new portions of channel through the merses of Kingholm and Nertherton might proceed without delay.

Upon examination of the old channel of the river, I found that the Kingholm quay was built upon an extensive field of rock, which advanced into the bed of the river upwards of 70 feet, in front of the quay, before it began to dip towards the west, at an angle such as it could reasonably be expected that the new channel, which must be formed upon the west side of this rock, could be improved to a sufficient depth without incurring enormous expenses. I, therefore, laid down the new line of this portion of the channel in such a manner that the whole of the channel would be formed upon the west side of this field of rock. The east side of the channel was consequently laid at the distance of 70 feet to the west of the quay. This deviation from the first proposed line, improved the line of the channel in connexion with the portions of new channel that were to be formed through Kingholm and Netherton merses, and at the same time it placed the new channel at this place in a position whereby it could be improved at moderate expense.

The line of the new channel through Netherton merse was placed upwards of 100 feet towards the west of the line orginally proposed; and it was made a direct line, and laid down so as to fall into the curves at each end of it, instead of being formed in a serpentine line. This alteration greatly improved the new line through this merse, as well as its connexion with the old channel at both ends of it.

A little above Kingholm quay there is a scar, which had formerly been the Kingholm harbour or landing-place. This scar had been formed by the washing away of the high bank upon the west side of the river, above Mavis grove, which had been composed of tilly clay, saturated with water, and filled with boulder stones. This bank having been worn away by the influence of the river floods, the clay having been drifted to the Solway, and the stones and gravel deposited in the channel, formed a bar immoveable by the influence of the floods; but it also formed a sheltered harbour for very small vessels. The tilly diluvium, which overlies a portion of the same field of sandstone rock, upon which the quay at Kingholm is built, extends across the channel at this point; consequently it may become a bar of rock within the channel at some future period.

While I was engaged in ascertaining the declivity of the low-water channel between Dumfries and Glencaple, and the various facts and circumstances connected with the practicability of improving the navigation of the river, I found that the inclination of the surface of the low-water channel, and the depth of the water within it were very irregular, which caused great irregularity in the velocity of the currents of the river floods throughout its whole length. I consequently had great difficulty in ascertaining the quantity of water discharged during river floods, and also the mean velocity of their currents, so as to obtain data from which I could calculate the area of a section that would be most suitable for the new channel; and at the same time to give to these sections such a form that the currents of the floods would assist in deepening the bed of the river; and also that, in the ordinary state of the river, the low-water and ebb tide currents would keep the channel free from silt. With the view to obtain as thorough a knowledge as possible of the quantity discharged in large river floods, I selected for that purpose the most regular portions of the old channel that I could find, and ascertained the area of their transverse sections; and upon the 1st November, 1811, I was, by a very large flood, furnished with the means of ascertaining that a section of the channel, the area of which, being 2,100 feet, and its depth being 13 feet 6 inches, would, with the central velocity of the currents of the four and a half miles in the hour, discharge the largest floods of the Nith. From this datum, which was corroborated by other observations regarding the quantity of water contained in a section of the large river floods, I calculated the section for the new channel.

I was not satisfied with the statements which were made by Mr. Hollinsworth and Mr. Buchanan, who had reported their opinions regarding the extent to which the navigation of the Nith was susceptible of improvement, I consequently extended my survey and chart to Southerness; and I likewise made a survey and chart of the whole of the Firth. While I was engaged with these surveys, I ascertained numerous facts relating to the tides of the Solway; to the declivity of the surface and bottom of the low-water channel; to the river floods; and to the fall of the diluvium which underlies the silt banks of the Solway and the estuary of the Nith, and which overlies the surface rock formation. These facts enable me to show, in the most satisfactory manner, that it is quite practicable to improve the navigation of the Nith and Solway, to a much greater extent than had ever been contemplated by those who had surveyed and reported upon the improvement of their navigation. I have, therefore, with the view that the channel will at some future period be improved to the utmost extent to which it is susceptible, laid down upon the chart of the Nith, which includes a portion of the Solway, the line which I propose for the low-water channel between Dumfries and Southerness; and I shall show distinctly that it is quite practicable to improve the Nith to such an extent, as to obtain a low-water navigation from the Irish sea to Dumfries. In order that the subject may be clearly understood, I will state a few facts which relate to the tides of the Solway, and the low-water channel of the Nith and its estuary.

With regard to the tides: I found that the lift or rise of the tide wave throughout the Solway, is very irregular in height, as also in the time of flowing and ebbing, and in the time of high-water. These irregularities arise, in a great measure, through the influence of the gales upon the surface of the tide waves, while they are heaving their waters from the Atlantic through St. George's Channel

APPENDIX C.

DUMFRIES.

No. 464.
Newall, on the Improvement of the Nith.

and the Irish Sea, and spreading them throughout the Firth. The configuration of the Firth and its sand banks has also a share in promoting the irregularities in the tides. Equinoctial spring-tides in the Solway rise 28 feet in height over the low-water. The difference of the lift of the high spring tides and low neap tides is about 12½ feet. The difference of the lift of high and low spring tides is about 6 feet 3 inches. And the difference of the lift of high and low neap tides is about 2 feet 9 inches. The following facts regarding the lift of the tides at different points within the Solway and Nith may be taken as data from which to ascertain the extent to which the navigation of the Nith is susceptible of improvement, so far as regards the rise of the tides.

A 20 feet tide, by "Holden's Tide Table," will, in moderate weather, rise over the low-water channel at Borran Point, above 26 feet 2 inches; at Glencaple quay above 17 feet 9 inches; at Kelton above 14 feet 6 inches; at Kingholm quay about 11 feet 6 inches, and at the dock of Dumfries above 6 feet 8 inches. It must, however, be kept in view that the spring tides at Borran Point recede considerably farther than neap tides, consequently, the surface of the low-water at that point is upon a lower level in spring than in neap tides; and the tides at that point never cease to be either ebbing or flowing. The bottom of the channel, at the breast wall at Glencaple quay, being 8 feet 5 inches above the level of the surface of low-water at Borran Point, there is thereby a long interval of low-water at that harbour. The bottom of the breast wall at Kingholm quay is 14 feet 8 inches above the level of the surface of low water at Borran Point; consequently, the difference of the lift of a 20 feet tide at Borran Point and Kingholm quay is about 14 feet 8 inches; and between Borran Point and Glencaple quay about 8 feet 5 inches. The influence of the tide currents caused great changes in the depth of the channel at Borran Point. The low-water channel at that point has often been upwards of from 30 to 15 feet in depth; but it was never known to be less than 8 feet in depth, but always deeper opposite to Arbigland, so that in a 20 feet tide, the lift of a tide-wave of 26 feet over the low-water channel of 10 feet, will give 36 feet in depth of water in the channel opposite to Arbigland. The area of the section of the low-water channel that is kept open in the ordinary state of the river by the influence of the river waters, and those of the receding of the tides, to the distance of about 5 miles below Conheath, is very irregular; it may be fairly estimated at from 600 to 900 feet of medium area.

Through the reach between Conheath and Borran Point the channel is continually altering its course between the light silty banks. Each set of spring tides alters its form, and keeps in motion an immense quantity of silt, which is drifted from place to place, throughout the whole of the Solway, by the influence of the irregular currents of these high tides. The waters of spring tides that overflow the higher silt banks, return to the channel through numerous swatchways and rivulets, that are formed through these banks, by streams of land water with the assistance of the receding tide waters. These streams drift along with them immense masses of silt; portions of which are swept away by the tides, and large portions of the heavier silt are deposited upon the sides of the channel, and form bars, which have an effect, similar to that of low jetties, in diverting the currents of each succeeding tide from the space that was occupied by the preceding ones; these bars have also the effect of retarding the regular lift of the head of the tide-wave. The regular motion of the tide-wave being retarded by these obstructions, the waters accumulate to a considerable height above the level of the channel which causes them to stream forward, more in the form and nature of a river current, than that of the regular heaving of the tide-wave, consequently the head of the tide-wave streams over a considerable extent of sand banks on both sides of the channel, with varied velocities and heights; at the same time that the channel is filled with the tide head or "bore." The currents of the tide-head, and those currents that follow it in succession, load the tide waters with silt, which is conveyed to the increasing silt banks throughout the Solway. These loaded waters deposit also portions of silt into eddies that are formed by the low protruding points that are formed upon the sides of the channel with the silt that is drifted by the rivulets that stream to it, and also into eddies that are formed from other causes. The rapid changes that take place in the direction of the channel between Conheath and Borran Point, are caused by the protruding points that I have described, and by the influence of the river floods, while they are streaming through a channel which has a great and a very irregular declivity, and formed with soft silty banks. This ever-shifting state of the channel renders the navigation very precarious; and at the same time occasions great detention to the vessels. The river floods and the currents that are generated by the tide waves are at present the great disturbers of the channel below Conheath, and cause daily change in its circumstances; but these most powerful agents may be made the most powerful instruments to assist in the improvement of the navigation of the Nith, if their influence be properly directed.

In consequence of the ever-shifting state of the low-water channel between Conheath and Borran Point, the longitudinal section of the bottom of the channel is continually varying its form. I shall not, therefore, refer to a particular section of the bottom of the channel through that distance, in order to show the extent to which the navigation of the Nith is susceptible of improvement; but shall, from the foregoing facts regarding the lift of the tide waves, and the general state of the declivity of the bottom of the channel, show distinctly that it is quite practicable to improve the Nith so as to obtain a low-water navigation from the Irish Sea to the dock of Dumfries of upwards of 10 feet in depth. In which case there would, in a 20 feet tide, be upwards of 36 feet in depth of channel, at the rocky bar below Castledykes; still bearing in mind that, by Holden's Tables, equinoctial spring tides generally rise to about 2 feet above this line, which would in such spring tides, give upwards of 38 feet in depth at the rocky bar below Dumfries. It must also be kept in mind that tides which lift 26 feet at Borran Point lift only 6 feet 8 inches at the dock of Dumfries, consequently, there is in such tides an irregular depth of channel through that distance, and an irregular declivity of the surface of the bottom of the channel of upwards of 29 feet when the depth of low water at Borran Point is assumed at 10 feet, the lowest depth ever known being 8 feet. Then say that a 20 feet tide rises 26 feet over this low-water channel at Borran Point, will give upwards of 36 feet in depth at that point, while the depth at Dumfries would be only 6 feet 8 inches, say in round numbers 7 feet. The surface of the tide being nearly upon a horizontal line, shows by its depth that the bottom of the channel rises between Borran Point and Dumfries about 29 feet. But when the low water is of greater depth at Borran Point than 10 feet, the inclination of the bottom of the channel is thereby increased. And it must be kept in mind that the difference of the time of high water at Southerness and at Dumfries is from 35 to 40 minutes, according to the state of the wind.

From the foregoing facts it will appear quite evident, that if the bottom of the channel between Borran Point and Dumfries were sunk to a horizontal line, at the depth of 10 feet below the level of the surface of low-water at that point, there would likewise be 10 feet in depth of low-water at the rocky bar, below Dumfries. Under these circumstances, there would be a navigable low-water of 10 feet near to Dumfries. But the surface of the river, and ebbing tide waters, would have an inclination from

APPENDIX C.

DUMFRIES.

No. 464.
Newall, on the Improvement of the Nith.

Dumfries towards Borran Point, which would give a little additional depth of water near Dumfries, if the bottom of the channel were upon a horizontal parallel line with the surface of the tides. The inclination of the surface of the tides would be modified by their varying circumstances, with the state of the river flood, and of the wind. This inclination might vary from six to two inches in the mile between these points. Four inches to the mile through that distance would give four feet of surface declivity to the new channel. It must also appear equally evident, that the tide wave which heaves its waters to the height of 26 feet over the low-water at Borran Point will, when they rise to a horizontal line, give a lift of 26 feet at Dumfries, which, being added to the low water of 10 feet, will also give 36 feet in depth at Dumfries. To sink the bottom of the channel to a horizontal line, and to form it in the manner which I have proposed, may at first sight appear impracticable; but a little reflection upon the nature of such operations, and the materials to be operated upon, will satisfy the reflecting mind that it is not only practicable, but it would be easily accomplished. It would, however, be a work of time.

Though it be quite practicable to sink the bottom of the channel between Dumfries Point and Borran Point to a horizontal or level line, yet with the view to economy, and in consequence of the small quantity of water that flows down the Nith in summer, I have proposed that it shall in the first place be sunk at Dumfries to the depth of four feet only below the level of the surface of low-water at Borran Point in a 20 feet tide. There would in this case be a declivity in the bottom of the channel between Dumfries and Borran Point of six feet, assuming 10 feet to be the smallest depth at that point. The bottom of the channel being lowered to this depth, there would then, in 20 feet tides, be 30 feet in depth of water at Dumfries. The bottom of the channel at Dumfries would consequently require to be sunk below its present level about 21 feet. At Kingholm it would require to be sunk about 18 feet. At Kelton, about 16 feet. And at Glencaple quay, and towards Airds Point, it would require to be sunk about 13 feet. From Airds Point downwards, the bottom of the channel would be formed without any difficulty through the silt banks, which are formed over the tilly diluvium which overlies the conglomerate rock. If the channel were sunk as now proposed, and the bottom formed between Dumfries and Borran Point, as regular as the materials of the diluvium would permit, the inclination would be upwards of six inches to the mile between these points.

It is an usual practice with engineers to calculate upon giving an inclination to the bed of a navigable river, in order that it may discharge its land floods; upon the principle that water, like every body to which motion can be given, will move down an inclined plane upon the well-known action of gravitation. But it is by no means necessary that the bottom of a river should be formed into a regularly inclined plane in order to discharge its waters; nor is it the fact that the beds of rivers are so formed by the action of their floods. The floods in rivers form surface declivities to regulate their own discharge, and the velocity of the currents of these floods is increased as they increase their volume of water and surface declivity, though the bottom of the channel may be upon a horizontal line. The floods of a serpentine river form the surface of their currents into a series of low undulations, which are modified by the flexures of the longitudinal line of the channel, and the velocity of the currents through such channel are very irregular, being much influenced by the form of the transverse section of the channel. Notwithstanding that, I have proposed the channel of the Nith at Dumfries, in the first instance, to be sunk to the depth of 4 feet only below the level of the horizontal line of the low water at Borran Point, in 20 feet tides, which would allow upwards of six feet of inclination to the bottom of the channel. I do not consider that any declivity in the bottom of the channel is necessary. I therefore contemplate that the low-water channel will at some future period be sunk to a much greater depth, approaching to the depth of the channel at Southerness, so as to render it more extensively useful.

The beds of many navigable rivers decrease in depth for some distance towards their outfall, notwithstanding that the surface of their currents have an inclination towards these outfalls. The modifications of the currents of large bodies of water streaming through the channels of rivers upon beds that are horizontal, or inclined, or undulated, or that are obstructed by irregularities upon their sides or bottoms, have hitherto been too little the objects of observation and of the study of engineers; their principles of motion are consequently but too little known. A large river, the channel of which being regularly formed, and its bed being upon a horizontal plane, heaves its waters *wave-like* towards its outfall; and, in a similar manner, the tide-wave heaves its waters wave-like into the channel. If the bottom of the channel be undulated, and, if the inclines of these undulations be steep, they will give birth to sections of currents that will ascend from these inclines, and stream through the great fluid mass, and present themselves upon the surface. If the sides of the channel be abruptly irregular, currents will be projected from them that will stream towards the centre of the channel in a similar manner. And if the bottom or sides of the channel be uneven, and rough with boulder stones, or other protuberances, innumerable little currents and eddies will be formed over and among these inequalities that will be proportional to their magnitude, and will form a vein of disturbed fluid, over which the great body of the water will stream with greater velocity than this section of disturbed and retarded waters, and over it the great body of the fluid will glide with increasing velocity, as it deepens from this vein towards the surface, or recedes from the sides towards the centre of the great stream; hence the diminished velocity of currents along the bottom and sides of the channels of rivers. The upper stream of this vein will be very irregular, and ever changing its form, and mingling with the superior fluid; it may be considered the bed upon which the great fluid mass rolls onward to its outfall. In comparing small things to great, such a bed as that which I have attempted to describe, as being formed over this disturbed vein, may in some measure be compared with the beds of ocean streams, which are currents rolling upon liquid beds. The gulf, and other ocean streams are beautiful illustrations of this fact. The currents of the Amazons and Rio de-la Plata have also been observed to send their currents to a great distance into the surface of the ocean. It has been often ascertained, that, by the influence of gales, currents are formed upon the surface of the tide-wave, which frequently stream in an opposite direction to the heaving of that great wave, and with varied velocity: two miles in the hour have been observed. In such currents the separating vein of fluid of the currents that are moving in opposite directions will be very irregular; blending, and separating as the superior current rolls in a series of waves over the inferior mass; and that inferior mass, or tide-wave, in the deep sea, may be conceived to roll over a body of still water. The depth of the surface currents will be proportional to the magnitude of the surface waves. The ideas which I have endeavoured to convey, by the foregoing description of the motion of the water within the channel of rivers, will be more clearly understood by consulting the sections which are sketched with the design to explain my views of these movements of currents within channels of rivers. But it may be here observed, that the distracted currents at the bottom and sides of the channel are the great cause of the changes that take place in the depth, and in the direction of the course of rivers.

It has been said that Lower Egypt is the gift of the Nile. With equal propriety of parlance, it may

No. 464.
Newall, on the Improvement of the Nith.

be said that the Holm and Merse lands which border the Nith are the gift of that stream. The most satisfactory evidence of this fact is afforded by the numerous bodies that have been found in alluvial plains along the margin of the Nith,—in the carses of Newabbey,—in the shore lands of Carlaverock and Ruthwell, and in the mosses of Kirkconnel, Mabie, and Lochar, and also in large tracts of shore lands in the parish of Kirkbean,—that all these tracts of land had, at some remote period, been portions of the Solway, or estuaries of the rivers that flow to it.

The plain through which the Nith has established its serpentine course between Dumfries and Glenhowan is narrow, and its surface is chiefly composed of fine alluvial soil, which had been washed from the lands of the higher districts. This alluvial deposit overlies an irregular gravelly stratum, which has also been drifted from the higher districts, and deposited over the surface of the argillaceous diluvium, that overlies the conglomerate rock, which is the surface rock along the east side of the Nith from Dumfries, to a considerable distance into the Solway Frith. The currents of the river floods being unable to remove this tenacious clayey diluvium, in consequence of the number of boulder stones that are embedded in it, which had become as compact upon its surface as a pavement.

While the Nith was establishing its course through its own little estuary, and forming the little alluvial plains along its margin, it would be subject to many changes in the direction of its channel. These changes would arise from the irregularity in the height and form of the surface of the diluvium, and of the gravelly banks that have been drifted to it, which would direct the currents of the river floods to stream upon the soft alluvial deposits that would be formed over these gravel banks, and thereby waste away these soft formations which would retard the progress of the formation of land throughout the little estuary. It is evident that this ever-changing of the direction of the channel of the Nith must have arisen from the various modifications of the currents of the river floods, caused by the great declivity and irregularity of the bottom of the channel and of the estuary.

The quantity of alluvial matter that is drifted from the higher districts by the Nith and its tributaries, and by the other rivers that pour their waters into the Solway, is very great; but that quantity cannot be ascertained with any degree of accuracy. From experiments, I have found that the amount conveyed by the Nith to the Solway by high floods is upwards of 1174 cubic yards in the hour, or about one pound in 32 cubic feet of water. From which I estimated that there is annually drifted by the Nith to the Solway from about 112,000 to 120,000 cubic yards. That portion of the Solway which is bounded by a line drawn from St. Bees' Head to Abbey Head on the south, by the shores of Galloway on the west, by a line drawn from Southerness to Beckfoot on the north, and by the shores of Cumberland on the east, contains about 142,060 acres. The portion upon the north of the line drawn from Southerness to Beckfoot contains about 55,680 acres. The Nith is calculated to drain about 324,560 acres. Then let it be assumed that there are 112,000 cubic yards of alluvial matters drifted annually into the Solway by the Nith; and that the Annan, and the Esk, and the Eden send each a similar quantity, these together would amount to 448,000 cubic yards. But there are many smaller streams that contribute largely to swell the sand-banks of the Solway. Through the shore lands of Galloway flow the streams of the Newabbey, the Drumburn, the Kirbean, the Southwick, and the Urr, and a number of other smaller streamlets. From the shore lands of Dumfriesshire flow the Lochar, the Brow, the Cummertrees, the Kirtle, the Sark, and a number of smaller streamlets. And through the shore-lands of Cumberland stream the Wampool, the Waver, the Derwent, the Ellen, and a number of smaller streams. The contributions of these smaller streams to elevate the banks of the Solway may be fairly estimated at 72,000 cubic yards, which is equal to about a sixth part of the quantity estimated to be drifted annually by the four larger rivers, which together will make 520,000 cubic yards. This immense mass of matter being annually drifted to the Solway, must be deposited somewhere. The grosser materials that are swept down the Nith are deposited in the channel, and the more light matters are deposited upon the banks of the Solway, and would there remain but for the action of the currents that are generated by the tide waves, which tend to alter continually the form of the surface of these sand-banks. The vast accumulations of gravel within the channel, and the little estuary of the Nith, have rendered the navigation very precarious, and if means are not taken to cause the drifted gravel to be deposited into proper situations, it will continue to accumulate within the channel to such an extent as to render the navigation of the river almost impracticable. But, on the contrary, if the currents of the river floods be so directed as to cause them to deposit their loads of drifted gravel upon the sides of the channel, it would be of the utmost importance, because it could then be applied to form the margins of the channel in such a manner as to resist the influence of the river currents, and thereby maintain a regular fair-way for navigation. The gravel within the channel is of great value in forwarding the improvements of the navigation, because it can, either by artificial or natural means, be removed to form the margin of the low-water channel.

WALTER NEWALL.

No. 465.

Report by WALTER NEWALL, Esq., C.E., *showing the state of the River Nith, in June*, 1836, *and the Improvements that were made upon its Navigation from that period to December*, 1840.

No. 465.
Newall, on the state of the Nith, 1840.

UPON my re-appointment, in 1836, to the office of engineer to the Nith Navigation Commissioners, I found, upon a slight survey of the river, that great alterations had taken place in the line of the low-water channel that was laid down by me during the period of my former employment. I found, also, that the portion of the river between Cargen Pow and Kelton had become almost impassable by vessels of from 50 to 60 tons burthen, even in high spring tides. So numerous and so great were the deviations from the proper line of the channel, and so obstructed had it become, that I found it absolutely requisite that the river and its estuary, between Dumfries and Glenhowan Point, should be accurately resurveyed, to ascertain the full extent of the changes that had taken place through that distance, in order that I might devise the best means of rectifying them with the least possible outlay, either by forming new portions of the line for the channel to correspond as nearly as possible with those that were formerly laid down, and which had remained unaltered, or by such other means as circumstances might permit. The time that would have been required to make this survey would have caused considerable delay in commencing the formation of a new line of channel between Cargen Pow and Boreland, a little below Kelton, which had become absolutely requisite. I, therefore, made a partial survey of that portion of the river, and a sketch plan of the channel between these points upon which I laid down the line for the new channel, and submitted it to a meeting of the Navigation Commissioners, upon the 11th July, 1836, at which meeting that line was approved of, and the works required to form it were ordered to be carried into effect.

APPENDIX C.

DUMFRIES.

No. 465.
Newall, on the state of the Nith, 1840.

As soon thereafter as my other vocations permitted, I made an accurate survey of the river and its estuary, from Dumfries to Glenhowan Point, and projected a chart of the channel through that distance. This chart shows the state of the river in June, 1836. After I had completed this survey, I found that the deviations from the proper line for the channel were so great in some parts that it was impracticable to improve it to the depth required with the funds of the trust.

Though I delayed to report as to the state of the river, after I had resurveyed it in 1836, yet I was prepared to do so; and I was likewise prepared to report as to the improved state of the channel in December, 1840, when the works were suspended, and to give an account of the improvements that were carried into effect from June, 1836, to December, 1840. But circumstances that do not require to be explained prevented me from doing so; and at present I would not have submitted this report but from a sense of justice to myself and a duty to the public. In justice to myself I felt constrained to correct the misrepresentations of my verbal statements regarding the practicability of improving the navigation of the Nith and Solway, and also to correct the misconstructions of my verbal statements regarding the outlay upon the improvements of the river between June, 1836, and December, 1840. As a duty to the public, I felt a desire to remove the misconceptions and prejudices that are entertained regarding the practicability of improving the navigation of the Nith and Solway; and to show the cause of the very tardy manner in which the improvements of the river have progressed since they were commenced in 1811; and at the same time to show that it is quite practicable to improve the navigation of the Nith and Solway with the funds of the trust to a much greater extent than that contemplated by the Commissioners, or by the engineers who reported on the state of the river and its improvements. Influenced by these motives, I submit the following report to the Nith Navigation Commissioners and the public, in which I have given a description of the condition in which I found the river in June, 1836, and also of the works that were carried into effect from that period to December, 1840; from which the great cause that has produced the effect of retarding the progress of the improvement of the navigation of the Nith and Solway between 1814 and 1836, a period of 22 years, will be very apparent. I have also shown that it is quite practicable to improve the Nith and Solway, so as to obtain a low-water navigation to the bottom of the dock at Dumfries.

In the early period of my employment as engineer to the Nith Navigation Commissioners, I laid down the line for the new low-water channel of the river, from Dumfries to Greenmerse Point, and conducted the operations that were carried on in the formation of the new portions of that line of channel through the merse of Kingholm and Nethertown, and various other important improvements that were required to form a new line of low-water channel through other portions of the river. Though the operations that were carried on during that period extended only to Cargen Pow, yet I had subsequently extended my survey to the mouth of the river, at Glenhowan Point, and projected a chart of the river throughout that distance, upon which I laid down the proposed line for the new low-water channel from Dumfries to that point. I also surveyed the whole of the Solway, in order to ascertain to what extent it was practicable to improve the navigation to Dumfries. From that survey I also projected a chart of the Nith and its estuary, and as much of the Solway as enabled me to lay down a line for a new low-water channel from Dumfries to Southerness. This chart is accompanied with a descriptive report, and such memoranda as show the extent to which it is practicable to improve the navigation from the Irish Sea to Dumfries. That report records also many important facts relating to the Nith and Solway, the knowledge of which is quite indispensible in order to form a correct opinion as to the practicability of improving the navigation. As that chart and report furnish a considerable portion of the matter from which this report is composed, so far as relates to the susceptibility of the improvement of the navigation, I shall therefore have occasion to refer to them, in order to show that it is quite practicable to improve the Nith and the fairway of the portion of the Solway connected with it, so as to give a low-water navigation to the dock at Dumfries.

Previous to my entering into the subject of the improvement of the navigation of the Nith and Solway generally, I must point out the deviations that had taken place in the line of the proposed new low-water channel between Dumfries and Kelton, which was laid down during my former employment, from which it will be seen that they have been the great cause of retarding the improvement of the channel throughout that distance. It will also be seen, that the result has been a most wasteful expenditure of the funds of the trust, and fearful loss of time, all of which have arisen from the injudicious operations of the Nith Navigation Commissioners, and from the operations of those proprietors along the banks of the river who were permitted by the Commissioners to construct works that were the most obstructive possible to the improvement of the channel. These circumstances have operated most powerfully to engender and foster the feelings of prejudice against the improvement of the river, which have obtained for the navigation a character for being of the most hazardous nature possible, and a subject upon which large sums of money have been expended, without producing a proportionate benefit, and therefore a hopeless subject as to the success of improvement.

The line of the new channel between Dumfries and Cargen Pow, being distinctly laid down and formed during my former employment, I was very much surprised when I made my late survey of that part of the river to find so many and such great deviations from that line in this short distance. Some of these deviations were such as to render impracticable the improvement of the channel, with the funds of the trust.

In order that the nature and extent of these deviations may be clearly understood, I have shown them with red lines upon the plan of the river that was made from my survey in 1836. The operations of the Commissioners previous to that period were principally confined to the portion of the river between Dumfries and Cargen Pow. I shall therefore, in the first place, proceed from Cargen Pow upwards to Dumfries, with my description of these operations and of the mischievous effects that the deviation from the proper line of the channel produced in obstructing the navigation and retarding the progress of the improvement of the river. I will then return to Cargen Pow and proceed downwards, and show the condition in which I found the portion of the river from that point to about a quarter of a mile below Kelton, thence to the mouth of the Nith. I will also show the pernicious influence that the works of proprietors on both sides of the river have had in injuring the channel, and also the injurious effects that had arisen from the want of skill in the Commissioners who conducted the works, in directing the currents of the river floods in such a manner as to deposit their heavy loads of drifting gravel into such situations as would have advanced the improvement of the channel, instead of allowing them to deposit their loads within the channel, and thereby obstruct the navigation. The propriety of adopting such expedients never could be entertained by those who ventured to take upon themselves the responsibility of directing the most delicate operations of engineering, such as the direction of

APPENDIX C.

DUMFRIES.

No. 465.
Newall, on the state of the Nith, 1840.

currents to remove gravel from the channel, and to deposit their loads into the situations required; because the first principles of the science were unknown to them, and the principles of the plans proposed for the accomplishment of the improvement of the Nith, with a limited revenue, were to them equally unknown. The consequence has been a fearful waste of the funds of the trust, in constructing works at heavy expense that have been removed at much greater expense than that of their original cost. Besides, there are many works that must also be removed.

By inspecting the chart referred to, it will be seen that very little deviation has taken place from the line of the channel formerly laid down through Nethertown Merse. There is, however, a small deviation at the upper end of the west side, which contracts the width of the channel so much at that point as to cause an irregularity in the velocity of the currents of the floods. This will require to be corrected. This new portion of the channel in 1836 was six feet of medium depth throughout its whole length.

Upon the east side of the river at the bottom of Rosehall Merse, there was a point that protruded into the channel considerably beyond the proper line. I caused a portion of this projection to be removed in 1838, but still much more will require to be removed to give the currents a proper direction.

Upon the west side of the river, between the head of the portion of new channel that was formed through Nethertown Merse and Laghall, two large stone jetties have been constructed in a very injudicious manner, and at very great expense. At the upper end of the up-stream jetty a small tidal wharf has also been constructed in a very improper manner, and at considerable expense. A wharf upon the west side of the river at or near to the site of the present one, is quite requisite; but the present one in its present position will not serve the purpose required. The present one will consequently require to be rebuilt in a proper manner, and to be extended in length to give additional berth room for vessels. In order that the line of the west side of the river may be properly formed to give an uniform velocity to the floods, these jetties and wharfs will require to be removed and remodelled in a proper manner, which will involve a considerable outlay.

At the point of Mavisgrove Merse a most injurious deviation has been made from the proper line of the channel. From the point of that merse, and along the side of the river towards Laghall Wharf, several jetties were protruded into the channel more than midway through the space that must ultimately be occupied by the new low-water channel of the river. By these jetties the channel was formed over a field of rock at Kingholm Quay that rendered the improvement of the river impracticable with the funds of the trust. The influence of these jetties caused the accumulation of an immense mass of gravel upon their down-stream side, which had risen so high that it ceased to be covered, except in high spring tides. Immediately below Kingholm Quay a large portion of Rosehall Merse was washed away by the influence of these jetties, and thereby gave additional width of space upon the west side for the accumulation of gravel over the space that must be occupied by the new channel. These jetties and a great quantity of the accumulated gravel have been removed at very great expense, and the line is now formed for the west side of the river as formerly laid down; but a great quantity of gravel must yet be removed, in order to give a proper direction and influence to the currents of the river floods, so that they may assist to deepen the channel upon the west side of the field of rock at Kingholm Quay. That quay, like many of the works upon the Nith, has been constructed without any view to the improvement of the river by deepening its channel. It is built upon an extensive field of conglomerate rock, which stretches into the bed of the river in front of the quay wall upwards of 70 feet, before it begins to dip towards the west, with an angle such as may reasonably be estimated that the new channel which must be formed upon the west side of it can be deepened, so as to render it navigable by large vessels, without involving an unjustifiable outlay in cutting rock. It must be kept in view that the Nith will, at some period, be improved so as to give sufficient depth of channel for a low-water navigation, in which case the bottom of the channel will require to be excavated to the depth of upwards of 20 feet below its present level through this part of the river. This excavation must be accomplished by the removal of the gravel and the diluvium that overlie the rock, and not by the cutting of rock. Though the jetties and an immense mass of gravel have been removed to form the new channel at Mavisgrove, yet, in consequence of the channel having been widened upon the east side by the wasting away of Rosehall Merse, and the greater depth of the channel which at present lies on that side, the currents of the floods will have little influence in removing the gravel from this newly-formed portion of the channel until it be sunk so low and be so formed that the currents of the flood will operate upon it.

Immediately above Kingholm Quay, upon the east side of the river, a considerable divergence has taken place, the channel being widened towards the east over a portion of the same field of rock upon which the quay is built; consequently the channel cannot be improved to the depth required for the reasons already given. The present effect of this deviation is, that it allows the tide and river floods to flow over a portion of this rock which must form no part of the channel, instead of streaming in the line that must form the new channel, whereby the influence of the floods is rendered of no avail in promoting the improvement of the channel; whereas, if they were directed into the new line of channel, they would assist in deepening it. This deviation will require to be rectified, which may be accomplished without involving a great outlay.

The next deviation that I found in proceeding from Kingholm Quay upwards, was at the bottom of the new channel which was formed through Kingholm Merse. In consequence of a portion of the lower end of the west side of this new channel having been allowed to recede westward from the proper line, too much space was given to the river floods, the consequence of which has been the accumulation of a mass of gravel upon the east side, which protruded into the channel so as to obstruct the regular flow of the tides; and also the action of the river floods upon the ford which lies immediately below that portion of new channel. In order to rectify these defects, I caused a quantity of the boulder stones that were removed from the shallow ford immediately below this portion of the new channel to be laid into the west side of the channel* to direct the currents of the river floods over that ford in such a manner as to assist in deepening it; and the result of these operations has been the means of deepening that ford to a very considerable extent. The boulder stones upon this ford are imbedded in the till-clay diluvium that overlies the surface rock, which is of the sandstone formation, and at this place the till-clay forms the bottom of the channel, so that it may reasonably be inferred that it overlies a portion of the same field of rock upon which the Kingholm Quay is built.

The new line for the channel between the portion that was formed through Kingholm Merse and Castledykes Rock was formed upon both sides of the river, but no attention had been paid to forward

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* These stones, very imprudently, have been removed to repair roads.

APPENDIX C.

DUMFRIES.

No. 465.
Newall, on the state of the Nith, 1840.

the improvement of this portion of the channel, consequently the wide space upon the west side of the new line gave room for the river floods to stream through, and also space to contain an immense mass of gravel upon the east side of the river, over which a forest of aquatic plants had sprung up, and promoted the accumulation of silt, as well as prevented the river floods from acting upon this accumulated mass. A considerable quantity of this mass of gravel was removed from the east to the west side of the river, to form the line as formerly laid down, which improved this portion of the river to a great extent, by directing the currents of the river floods through the proper line of the channel, whereby their influence in deepening the channel will have the desired effect. This improvement was effected by a considerable outlay.

With regard to the barrier of rock at the bottom of Castledykes Pool, which could not be avoided in the formation of the new line of channel, and which has hitherto been a great obstruction to the navigation of the upper part of the river, I may observe that in order to remove this barrier in a systematic manner, the channel was divided into two portions of equal width, so that one-half of the width of the channel could be under the progress of being quarried, while the other half would give free access to the shipping. During the period of my former employment, I removed upwards of 300 tons of rock from the east half of this barrier, the removal of which involved a considerable outlay, because the whole of it was blasted and quarried under water; but the object in view was obtained, which was to render this half deeper and safer to navigate; and to lay the west half of the rock dry, so that it could be quarried to advantage. Part of the rock from this excavation was removed to the east side of the river to form the line of the side of the channel through a deep serpentine pool. The other portion was removed to Powsands to form the line along the west side of the river. From June 1836, to November 1840, I removed upwards of 2000 tons of rock from the west half of this barrier. The quarrying of the rock on this latter occasion was proceeded with in conformity to the former plan, which was to excavate this west half of the channel to the depth of about three feet below the level of the bottom of the channel on the east half, in order to give about three feet of greater depth of navigable water, and at the same time to form this half of the channel in such a manner that it would discharge the waters of the ordinary state of the river upon a level so low that the rock of the east half would have been laid dry, so that it could have been quarried out in a similar manner, and to a similar depth below the bottom of the west side, so that by progressing with quarrying alternately each half of the channel in the manner described, the improvement of this portion of the river would keep pace with the deepening of the channel below it. While the latter quarrying of the rock upon the west side of the river was in progress, I considered it to be advisable to remove the whole of the conglomerate rock from the top of the sandstone over which it lies, because by doing so the quarrying of the sandstone would, in future, be accomplished with comparatively little expense, because little of it would require to be blasted. The conglomerate rock was found to be very irregular in depth: at some places, upwards of seven feet. The bottom of the excavation is consequently very irregular, some parts of it being five feet below the level of the surface of the rock upon the east side; but there are three or four places where the sandstone will require to be removed in order to give the depth of three feet under the level of the east side over its whole surface, so that it may contain the whole of the low water of the ordinary state of the river, and give three feet of increased depth of navigable water. These operations were accomplished with considerable outlay; but when finished, and this half of the channel opened, the navigation will be much improved.

Before I leave this locality, I may observe, that it was contemplated, when the works were suspended in 1840, to form a temporary wharf upon the east side of the river and down-stream side of this rocky barrier for steam-packets and other large vessels, because there was then the near prospect of lowering the bottom of the new formed channel between Cargen Pow and Boreland, and that of the ford below Kingholm New Channel, to the same level with the bottom of the channel at Boreland and the new channels through Kingholm and Nethertown Merse, which would have given upwards of from 18 feet to 20 feet of water up to this barrier in 20 feet tides by "Holden's Tide Table," which is as much as there is generally through the reach, between the mouth of the river and Borran Point. In this case there would be more water up to Castledykes than there is at Glencaple Wharf, and six feet more than there is along the side of the wharf and basin at Kingholm. Though the bottom of the channel at Glencaple is from four to five feet deeper than at the breast wall of the pier, yet advantage cannot at present be taken of that extra depth from the obstructed state of the sea-reach below the mouth of the river.

The field of rock that bounds the east side of Castledykes Pool was very imprudently lowered in height, by quarrying and removing the rock from its surface, which allowed the river floods to stream over it, and thereby promoted the growth of merse land and the accumulation of gravel in front of Moat Holm, and also the filling up of that pool by the lodgment of large stones. A considerable quantity of gravel was removed from this accumulated bank to the east side of the river, to fill up a portion of the space from which the rock was removed; but a much greater quantity must be removed to give the channel its proper form, in order to direct the river floods to stream through this pool in such a manner as to preserve it as a resting place and draught pool for fish, as well as to improve the navigation.

The wharf, which is built at the up-stream end of Castledykes Pool, is placed considerably too far eastward of the proper line of the channel, which has caused a lodgment of large boulder stones in the middle of the channel in front of it. In consequence of this quay being built upon a high shelf of rock, at a considerable distance from the line of the channel, it never can be available as a wharf except for small craft.

An island was formed in the channel, opposite to the Infirmary, by the gravel that was swept from the bottom of the channel in front of the retaining wall that was built for a wharf at the head of the dock. This island, which had become a great bar to the navigation, was removed, and the channel partially improved at this place. Between that point and Castledykes Wharf, a considerable quantity of gravel was removed from the channel and laid upon the east side of the river, to assist in forming the line of the channel upon that side, preparatory to the formation of a wharf wall that should be constructed between Castledykes and the head of the dock. This retaining wall, or tidal wharf, should be commenced upon the rock at Castledykes, and proceed upwards as the channel is increased in depth, so that it may be all founded upon rock, and as the funds of the trust will permit.

The last deviation that I shall notice in the upper part of the river is the great retaining wall at the head of the dock. This wall is placed much too far into the channel of the river, and like the jetties at Mavisgrove Merse, it throws the channel over a field of rock upon the west side of the river, which cannot be removed in order to deepen the channel without involving a very unjustifiable outlay. A portion of the space which must be occupied by the channel is now occupied by this wall, together with

APPENDIX C.

DUMFRIES.

No. 465
Newall, on the state of the Nith, 1840.

the ground to the east of it, which was taken off the river when the wall was built. This wall has never been available as a wharf, and if in its present position it were practicable to use it as such, great inconvenience would be experienced by the trade from the narrowness of the channel, particularly in the time of river floods, when their velocity would be increased by the displacing of a large section of their area by a row of vessels lying along the side of the wharf. This increased velocity would render their mooring unsafe, and their moving from it inconvenient and hazardous in the limited space in which they would have to wind large vessels. If ice were floating in the river during river floods, the current would sweep it along the side of the vessels with such velocity as to do great damage to them. The projectors of this expensive work must have entertained magnificent ideas regarding the rise of the tides at the head of the dock, because they caused this wall to be raised upwards of four feet higher than the highest tide within the Nith. It appears also that they must have contemplated improving the navigation of the river by raising the waters within the channel, and not by deepening the bed of it, because the foundation of this wharf wall is upwards of four feet above the level of the bottom of the channel in front of it, and when the channel is improved even to a very limited extent, its foundation would be upwards of 12 feet above the surface of low water. But for the mass of stones that were placed along the front of its footing, it would have been, long ere now, launched into the channel a shapeless ruin; consequently the means that were employed for its preservation rendered it unsafe for a tidal wharf. From what has been said regarding this costly and fragile fabric, it must appear quite evident that ere long it must be removed from its present situation, and the channel of the river widened upon the east side, in order that it may be deepened without the interference of rock. I think it will likewise appear quite evident that the whole of the outlay connected with this wall and the earth work upon the east side of it has been thrown away, and the expense of removing it and the earth works, which will be very considerable, will, except the value of the stones, also be thrown away.

I shall now return to Cargen Pow, and describe the state in which I found the channel between and Boreland in 1836. In referring to the plan of this portion of the river, it will be seen that the channel was divided into numerous little irregular pools and fords, resembling a series of lagoons more than a navigable river, so much was the channel divided and distorted, and so numerous and so elevated were the gravel banks within it, that it had become most difficult and dangerous to be navigated in any state of the tides even by vessels under 50 tons burthen. Indeed an inspection of the plan of this part of the river will excite astonishment that any attempt was made to navigate it at all. Having stated the above facts, I feel regret that I am constrained to remark that the sole cause of this distracted state of the channel arose from the ill-directed operations of the Commissioners, and from those of the proprietors of lands on both sides of the river who were permitted by the Commissioners to protrude jetties from the sides of the river that were the most adverse to the improvement of the navigation. The proprietor of the lands of Greenmerse was permitted to project jetties from the point of that merse, which extended through the whole width of the space that should have been occupied by the new line of the channel of the river. These jetties did not only occupy the space which should have been occupied by the channel, but they caused accumulations of very extensive banks of gravel on each side and in front of them. A great number of other jetties were protruded from both sides of the river, which were likewise very adverse to the improvement of the river. The only other jetties that I shall notice is the great stone one that was constructed by the Commissioners at great expense opposite to Cargen Pow, but for what purpose it was constructed I have not been able to learn, nor could anything be more injudicious than its construction. The whole of these works between Cargen Pow and Boreland which I have numerated were expensive in their construction, and pernicious in their effects, so much so, as to render imperative the removal of the whole of them that approached near to the new line of the channel, and the formation of a new line of channel between Cargen Pow and Boreland through high gravel banks, the distance being one mile and a half.

The whole of the jetties that were at Greenmerse Point, and all those along the side of the lands of Netherwood, have been removed, and the new line of channel formed between Cargen Pow and Boreland, which have involved a very heavy outlay. Though this new line of channel is now formed, yet its bed is not laid upon so low a level as to give proper effect to the action of the river floods to assist in deepening it, nor is the line on all its parts perfectly formed. I may here remark, that it is to be regretted that the line which was formerly laid down for this portion of the channel was not strictly attended to, because it was superior to the line which is now formed to suit the altered circumstances of the river. The jetties that the proprietor of Greenmerse was allowed to protrude from the point of that merse had promoted the growth of a portion of new merse on the down stream side of them, the removal of which, and the damages that might have been claimed, would have been considerable; it was, therefore, considered to be more prudent to avoid any question that might have arisen in attempting to form that line. But the Commissioners must still bear in mind that the line of this portion of the channel has been damaged by the imprudent proceedings of their predecessors in office. It is likewise to be regretted that proper attention had not been given to this portion while the operations were in progress in the upper parts of the river; because, if the currents of the river floods had been directed with intelligence, they would have caused to be deposited the heavy loads of gravel, which they drifted from the upper parts of the new formed channel, into situations where it would have been required for the purpose of forming the sides of the new channel through this lower portion of it.

From the foregoing facts it must appear quite evident that the principal part of the expenses that were incurred in improving the navigation of the Nith, between June 1836, and January 1841, were expended in removing works that had been imprudently constructed by the Commissioners, or by those proprietors who were permitted by them to construct such works, and in removing masses of gravel that had accumulated in the channel through the influence of these imprudent erections; consequently, the expenses that had been incurred by the Commissioners and the proprietors of the lands of Greenmerse and Netherwood, in constructing these works, have been entirely thrown away; and also the expenses of removing them, which amounted to 4,431*l.* for labourers' wages, exclusive of tools, punts, and boats, &c: amounting to upwards of 400*l.*, have also been thrown away, with the exception of about 160*l.*, for cutting rock at Castledykes, and about 250*l.* for other small improvements, amounting to not more than 410*l.* The formation of the new channel between Cargen Pow and Boreland has involved ten times the amount of expenses that would have been required to form it in 1814, through that distance, and in a superior line. But what is much worse than the waste of the money, the channel, by the influence of the river floods and the jetties already described, has been rambling from place to place, through a wide space of gravel banks, for upwards of twenty years, to the great annoyance and danger of the shipping, without obtaining one inch of greater depth of water during the period from 1813 to 1836.

No. 465.
Newall, on the state of the Nith, 1840.

If proper means had been taken to form the line of the channel between Cargen Pow and Boreland, and if the currents of the river floods had been assisted to deepen the channel, and directed so as to deposit the heavy loads of drifted gravel into such situations as would have improved the river, instead of allowing them to run at random among gravel banks, and deposit their loads within the channel, to form obstructions to the navigation, as they had done through a period of upwards of twenty years previous to 1836, the channel would have been improved, so as to have given at least 20 feet of tide water in 20 feet tides, up to the rocky barrier at Castledykes previous to that period, and with much less outlay than was incurred with the construction of those works that have now been removed with such fearful expenses. Upwards of twenty years have thereby been lost to the improvement of the navigation, and upwards of 10,000*l.* to the funds of the trust; because, when the new channel was formed between Cargen Pow and Boreland, in 1840, the river through that portion was little farther advanced in improvement than it was in 1814. Not one inch more in depth of water had been obtained, although the portions of new channel were six feet to nine feet in depth, yet that depth was not available, in consequence of the obstructions below them; and these portions of new channel were prevented from being further deepened by these obstructions, keeping them standing in deep pools of comparative still water, except in times of river floods and the time of the flowing and ebbing of the tides.

In order to illustrate still farther the propriety of proceeding with the improvements in a systematic manner, I will adduce as examples the two portions of new channel that were formed through the merses of Kingholm and Nethertown, which were formed in a proper manner, and compare their state with that of the other portions of the river in 1836. At this period the low water in the new channel that was formed in Kingholm Merse, there was from six feet to nine feet in depth of low water; and in that formed in Nethertown Merse, the depth was six feet. But immediately below Cargen Pow there was a long oblique ford, that was only five inches deep in the same state of the river. From that ford to Boreland, a little below Kelton, the declivity of the surface of the low water, through a mass of gravel banks, was upwards of three feet; and the depth of the channel at Boreland was upwards of three feet, consequently the gravel banks formed a bar to the navigation of that portion of the river of upwards of six feet between these portions of deep channel. But in the line of the new channel through that distance, the greater portion of the gravel banks that were then to be removed were upwards of three feet in height above the level of the surface of low water, which had accumulated from the causes already shown. In a 20 feet tide there was upwards of 18 feet in depth of tide water in the channel opposite to Boreland, and about the same depth in the new channel through Nethertown Merse, but over the bar below Cargen Pow there was not 12 feet in depth. The new channel being now formed through these gravel banks, and so soon as it is deepened to the same level with the channel through Nethertown Merse, there will be 18 feet of water up to Kingholm Quay in 20 feet tides; and the same horizontal line of the bottom of the channel being continued through the ford at the bottom of the new channel in Kingholm Merse, and a small portion between that new channel and the rocky bar at Castledykes, there will be 18 feet of tide water to that point. And if the whole of the channel from the line of Glencaple Quay to the rock of Castledykes be cleared out to the depth of the channel at Glencaple, there will be upwards of 20 feet of tide water in a 20 feet tide by "Holden's Table;" and this is the greatest available depth that can be obtained, so long as the improvements of the navigation are confined to the river.

I will next direct the attention of the Commissioners to the reach of the estuary of the Nith, and that portion of the Solway that lies between Glencaple and Arbigland. The lift of the tide wave over the low water opposite to Arbigland, in 20 feet tides by "Holden's Table," is upwards of 26 feet, and the depth of the channel at the same point may be assumed at 10 feet, though it is generally a much greater depth. The same tide of 20 feet rises over the low water on the down stream side of Castledykes rock 10 feet 6 inches, and the depth of the low water at that point may be stated at 2 feet. Assume, then, that the surface of the tide wave would rise to a horizontal line, there would be upwards of 36 feet in depth opposite to Arbigland, and 12 feet 6 inches in the down stream side of the rocky bar at Castledykes. Then let it be also assumed that the bottom of the channel between these points can be deepened to a horizontal parallel with the surface of the tide, at the level of 10 feet below the surface of low water opposite to Arbigland, there would in that case be 36 feet in depth of water at the down stream side of the Castledykes barrier in 20 feet tides, and 10 feet at low water. But it may be observed that the tides will rise to a horizontal line throughout that distance, if the channel be properly formed. Then on the receding of the tide waves, a declivity would be formed in their surface in order to discharge the waters through the contracted part of the river. This surface declivity would be modified by the velocity of the tide waters receding through the Irish Sea; and that modification would be regulated by the height of the spring and neap tides respectively. Let it be assumed that, in spring tides, which recede with the greatest velocity, and to the lowest level, that a surface declivity would be formed of 2 inches in the mile, and the distance being about 12 miles between Castledykes and Arbigland, there would in this case be a declivity of the surface of 2 feet in that distance at the time when the tides have receded to the lowest level at that point. From the time that the tide began to return from that lower point, the surface declivity would gradually diminish until the head of the tide wave would again elevate the water at Castledykes. From the foregoing statements, you will perceive that, to obtain a low-water navigation of 10 feet to Castledykes, the bottom of the channel would require to be lowered about 23 feet below its present level, and the new channel immediately below it, which is at present from 6 to 9 feet deep, would require to be lowered about 16 feet. All this appears to me to be quite practicable with the revenue of the trust; but time would be involved, because a great part of the work would require to be performed with the scouring influence of the currents; and this would be easily accomplished, particularly through the reach between Glencaple and Arbigland.

While I make the foregoing statements of facts regarding the works of the Commissioners, I wish it to be distinctly understood that I do not impute improper motives to those who directed the operations upon the Nith, because I believe they were most desirous to promote the improvement of the navigation, and were actuated by the purest motive, and conducted the operations to the best of their skill in such matters; but unfortunately their inexperience in engineering, their limited knowledge of the circumstances connected with the Nith and Solway, and with the plans that are practicable to be carried into effect for their improvement, led them into innumerable errors that proved fatal to the progress of the improvement of the navigation of the Nith and of the prosperity of the town of Dumfries and the surrounding district. My object in making the foregoing statements is to direct the attention of the present Commissioners to the errors of their predecessors in office, and to beg of them to reflect dispassionately on what has been stated; because if they do so, they will be influenced to proceed with the improvements of the navigation in such a manner as to avoid the necessity of having

APPENDIX C.

DUMFRIES.

No. 465.
Newall, on the state of the Nith, 1840.

their works undone or altered, after the lapse of years, in order that the improvements may be recommenced so as to progress with them in a practicable and systematic manner, to obtain a low-water navigation from the Irish Sea, to within a very short distance of Dumfries, which is quite practicable with the funds of the trust.

While I have shown that much money has been imprudently expended upon improper works, there has also been much applied very usefully, which has been the means of improving the navigation very materially. In referring to expenditure, it is always to be understood to be proportional to the funds of the trust.

WALTER NEWALL.

To the Nith Navigation Commissioners, Dumfries.

No. 466.

Answers to 120 *printed Queries circulated by the Tidal Harbours Commission.*

No. 466.
Answers to printed Queries.

THE port of Dumfries is situated within the Solway Frith and River Nith. As regards the levying of dues for the improvement of the navigation of the Nith, and the maintaining of lights and buoys, it extends from Dumfries to Southerness. There are eight harbours or landing places, within the port, viz., Glencaple quay, Kelton Scar, Kingholm quay, Laghall quay, Castledykes quay, and Dumfries quay; these six are within the river. There is one landing place within the Solway, at Carse-thorn; and another small quay within Newabbey Pow. Cargoes are also landed at Southerness.

The harbour at Carse is an open sea-beach. It is rather exposed to the easterly gales; but there is little sea room to generate large surface waves, as they have to be formed in shallow water over high sand-banks. Glencaple quay, near the mouth of the river, is rather exposed to westerly gales.

Carse is a natural scar harbour; Glencaple, a tidal pier; Kelton, an open scar; Kingholm, a small tidal basin and wharf wall; Laghall, a small tidal pier; Castledykes, a small tidal wharf wall; Dumfries, a small tidal wharf wall; Newabbey, a small tidal wharf wall.

Carse is often run to by small vessels, as a harbour of refuge. There are about two miles in length of anchorage ground, between Carse Pow and Arhigland, which is partially sheltered from southerly and westerly gales.

The anchorage ground at Carse-thorn is principally composed of clay. In some places it is covered with gravel, and in others with sand and shells, &c.

At present, there is not two fathoms water at any of the harbours or landing places. These harbours are all tidal, and dry at low water. There is a portion of low water within the port, between Southerness and Borran point, that is from two to six fathoms in depth.

The fair-way of the entrance to the port at Southerness, is E.N.E., and fair-way of the entrance of the mouth of the river, is north. The width of the low water at Southerness, is about two miles and a half, and the width of the low-water at the mouth of the river, at Airds point, is about one furlong; but at high water, the width at the mouth of the river is about six furlongs.

The depth of the low-water channel at Southerness is from three to six fathoms. The depth of the low water at the mouth of the river, at Airds point, varies almost in the course of every set of spring tides, particularly in summer. The medium depth may be stated at three feet. From the mouth of the river upwards to Dumfries, the depth of the low-water channel varies from 2 to 9 feet, and in one pool upwards of 12 feet in depth.

In consequence of the influence of the winds, the lift of the tides of the Solway is very irregular; but as a mean they may be stated as follows—viz., by "Holden's Tide Table" the rise (of 20 feet tides) at Southerness and Carse, is about 26 feet; at Glencaple pier about 17 feet 9 inches, at Kingholm about 11 feet 6 inches, at the dock of Dumfries about 6 feet 8 inches; equinoctial spring tides generally rise 2 feet higher than the above scale. There is about 12 feet 6 inches of difference between high water of high spring and low neap tides.

At Southerness it is high water, on full and change days, at 20 minutes past eleven; at the mouth of the river, 30 minutes past eleven o'clock, and at Dumfries at twelve o'clock.

The velocity of the currents of the tide waters within the channel of the port of Dumfries is very various, which arises from the serpentine and undulated state of the low-water channel. In ordinary spring tides, the head of the tide wave streams through a well-defined portion of the low-water channel at the rate of five miles an hour; but in many places the velocity is greater. It may be observed that, in this case, the tide streams through the channel as a current impelled by a head of water, and not as a tide wave. It may be observed, also, that the currents in some cases are moving up the inclined bed of the channel. The velocity of the top of the tide wave from Southerness to the mouth of the river is upwards of 42 miles in the hour. From the mouth of the river to Dumfries, it is about 14 miles in the hour. The velocity of the central current of large river floods is about five miles in the hour. In very large floods it is much greater; but this velocity is not uniform throughout the whole length of the tidal portion of the river.

There are no wet docks, graving-docks, or floating basins within the port. There is a small tidal basin at Kingholm.

There are no ship-building slips, patent slips, nor repairing docks. Repairs are generally executed upon the beaches of Kelton and Glencaple. Twenty-five shipwrights are employed.

There are 1014 yards lineal of wharfage within the port;* but 233 yards of it, which were built in

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* Glencaple	127	yards
Laghall	25	,,
Kingholm	277	,,
Castledykes	115	,,
Dumfries	470	,,
	1014	,,
Unavailable at Dumfries	233	,,
	781	available.

APPENDIX C.

DUMFRIES.

No. 466.
Answers to printed Queries.

the year 1824, have never been available, because it is improperly constructed. There are no cranes upon the wharfs.*

There are abundant supplies of provisions. The greater part of the coal is imported. There are no regular ship stores; water is obtained at all the harbours and landing places, but it is not led down to the quays.

The steamer is supplied with coal at Liverpool. There is no low-water pier within the port, nor are there any floating depôts of steam coal.

The chief traffic is general merchandize, coast ways, and timber, foreign. The inland traffic is general merchandize.

The inland communications from the harbours are all by good roads.

There is one small steamer of 127 tons, with two engines of 50 horse power each.

The recent plans of the port are:—1. Plan of the port, which includes the Nith and part of the Solway, surveyed by Walter Newall in 1836: scale six inches to the mile.—2. A plan of the river surveyed by Walter Newall in 1836: scale 15 inches to the mile.—3 A plan of the port reduced to a scale of two inches to the mile, from the survey of 1836, by Walter Newall.

The old plans are—1. A plan of the river, surveyed in 1810, by Mr. Jardine, surveyor, and lodged in the sheriff-clerk's office.—2 A plan, showing the state of the river from Dumfries to Greenmerse Point, surveyed in 1811, by Walter Newall: scale 15 inches to the mile.—3. A plan of the river, from Dumfries to Glenhowan Point, surveyed by Walter Newall, in 1811, 1813, 1814, and 1815, being a continuation of the survey of 1811: scale, four inches to the mile.—4. A plan of the port from Dumfries to Southerness: scale, 10 inches to the mile, being from the survey in 1811, 1813, 1814, and 1815, by Walter Newall.

1. A plan surveyed in 1810, showing the improvements projected by Mr. James Hollinsworth. This plan is to be found in the sheriff-clerk's office, Dumfries.—2. A plan † showing the state of the river between Dumfries and Greenmerse Point, in 1811, and also the line of the projected improvements through that distance, by Walter Newall: scale 15 inches to the mile.—3. A plan † which shows the state of the river between Dumfries and Greenmerse Point, in 1811, together with extended survey to Glenhowan Point, in 1813, 1814, and 1815, upon which is laid down the projected line for improvement through that distance, by Walter Newall.—4. A plan showing the projected improvements of the channel between Dumfries and Southerness in 1815, by Newall: scale, 10 inches to the mile.—5. A plan ‡ showing the projected improvements of the channel of the river, and of the Solway from Dumfries to Southerness in 1836, by Walter Newall: scale, six inches to the mile.

The Engineers' Reports are by Mr. James Hollinsworth, 21st July, 1810. Report by Mr. Robertson Buchanan. Memoranda on the Nith and Solway, by Walter Newall in 1815, showing the practicability of improving the Nith so as to give a low-water navigation to Dumfries. Report regarding the improvements of the navigation of the Nith and Solway, by Walter Newall, in 1841.

The best chart of the Solway is by Captain Robinson, R.N. It is from a Government survey in 1837, and corrected down to 1841. The only sailing directions are by Mr. Norie and Mr. Lawrie.

In consequence of the ever-changing state of the low-water channel through the reach of the Solway, between the mouth of the Nith and Borran Point, there is no plan nor chart that shows the present state of the channel through that distance. The plan projected from the survey by Walter Newall, of 1836, shows the present state of the channel of the river, nearly from Dumfries to its mouth at Glenhowan; but the new channel that was formed between that period and the end of 1840 is only indicated by brown tints. It extended from Cargen Pow to Boreland.

In 1811 the channel of the river between Dumfries and Kelton was very serpentine, and much obstructed by fords, so that the navigation was almost impracticable between Kelton and Kingholm quay. The navigation of the portion of the river between Kingholm quay and Dumfries was seldom attempted, except by very small craft. The plan, from the survey of 1811, shows the state of the channel at that period. The spring tides in 1811 rose to the same horizontal line that they do at present, as near as can be observed. At that period a 20 feet tide, by Holden's tide table, rose, at Dumfries 6 feet, at Kingholm quay, 11 feet 6 inches, and Kelton Ford, 14 feet 6 inches; but at Shed Ford, which was about ¾ of a mile above Kelton, it gave only 12 feet. At that period the channel did not run to Glencaple quay; Kelton, Conheath, and Hag scars were the lower landing places. Since 1811 a portion of new channel has been formed through Nethertown merse; the depth of low water of which is 6 feet. The river between Kingholm quay and Castledykes has been very much improved. A portion of new channel was formed through Kingholm merse, the depth of the low water of which is from 6 feet to 9 feet. A little rocky hill, which was covered with trees, protruded into the channel a little below Castledykes, and formed a great obstruction to the navigation. That little hill was removed, and the new line of channel formed at that place. A great mass of rock was removed from the channel at that place, which now gives upwards of 3 feet of additional depth of water up to Castledykes quay. A small wharf has been built at Castledykes. A wharf 233 yards in length was formed at Dumfries, but in so injudicious a manner that it has never been available as such. Between the 10th June, 1836, and 2nd January, 1841, a portion of new channel was formed between Cargen Pow and Boreland, a little below Kelton, through the distance of a mile and a quarter; but the operations were suspended before this portion of the channel was completed, consequently there has been little increase in the depth of water through that distance. In the formation of this portion of new channel, it was contemplated to run it out so deep, as to drain the 6 feet of water out of the new channel that was formed through Nethertown merse, and thereby give 6 feet additional depth of water up to Kingholm quay, which would then have been equal to 17 feet 6 inches in 20 feet tides. Operations were in progress to carry onwards a similar depth from Kingholm quay to Dumfries; and to increase that depth between Boreland and Dumfries, so as to give 20 feet in depth in 20 feet tides, which is the greatest available depth that can be obtained until the low-water channel from the mouth of the river downwards be improved, which can easily be effected with the revenue of the Trust: but a considerable time would be required to accomplish it.

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* This wharf, of 233 yards in length, is protruded into the channel in such a manner as to throw it over a field of rock upon the west side of the river, through which rock the channel cannot be formed to the depth required without involving an outlay that the funds of the Trust cannot sustain. This wall will, therefore, require to be removed and rebuilt in a proper manner.

† A tracing of these plans is sent, along with this, to the Tidal Harbours Commissioners.

‡ A tracing of a portion of this plan is sent to the Tidal Harbours Commissioners, and also a tracing from a reduced plan of this survey, which is on a scale of two inches to the mile.

APPENDIX C

DUMFRIES.

No. 466.

Answers to printed Queries.

The channel through the reach, between the mouth of the river and Borrau Point, is ever changing its course. It is considerably shallower than in 1811, particularly in the lower end. Since that period many millions of cubic yards of alluvial earth and sand have been drifted to the Solway, and spread over its banks. The changes of the set of the tides are influenced by the changes of the course of the channel.

Several changes have been made in the channel of the river by encroachments, but they have generally been removed at great expense. Numerous changes have been made by natural causes, such as by the drifting of gravel and sand down the river, and the lodgments of them in the channel. All the changes that take place below Glencaple and Kirkconnel jetty are from natural causes.

A change was caused by the erection of Glencaple pier, and several changes have taken place by the erection of jetties. The pier at Glencaple was erected by the town of Dumfries. Jetties were erected by the Commissioners and by the proprietors, with the consent of the Commissioners; but they have been removed. The pier at Glencaple now ceases to do much injury; and if the proposed improvements of the river be carried into effect, it will entirely cease to do any injury.

The small basin at Kingholm has a tendency to silt up: it is kept open by sluicing. Every part within the port has a tendency to silt up, where it is protected from the influence of the river floods and the current of the receding tides. But no part of the improved channel has any tendency to silt up in the ordinary state of the river.

There is no bar formed across the mouth of the river. From the mouth of the river downwards to Borran Point this reach is a continuous bar of silt, through which the channel is continually changing its course. The bars within the river are chiefly formed with gravel, but there is one bar of rock at Castledykes

The bottom of the river is composed of gravel that has been drifted to it by the river floods.

There is no dredging machine in use, nor can any be used in the present state of the river.

The quays and piers are constructed with sandstone; and the stone is not bored with any sea-worms, none of the quays being formed under low water.

The average size of the stones used in the construction of the quays is about 8 cubic feet, and the maximum about 16 cubic feet.

There is no timber used in the quays as front fenders. The top fenders are of pine timber.

The valley drained by the Nith is calculated to contain upwards of 67 square miles, or 324,560 acres of land within the counties of Dumfries and Kirkcudbright.

The available back-water for drifting gravel to or from the navigable portion of the Nith, and the alluvial earth and sand to the Solway, is the water from the drainage of the valley, containing upwards of 324,560 acres of surface, a considerable portion of which is pasture land. The area of the section of large river floods, which stream from that valley through the navigable portion of the river, is about 2,100 feet: such floods stream down the channel with the velocity of 5 miles in the hour.

The area of the section of the improved portion of the river, in 20 feet spring tides, may, at present, be estimated at 1,600 yards superficial.

The area of the low-water channel, at the mouth of the river, is about 75 yards, and the area of the section of 18 feet spring tides is about 5,300 yards.

High spring tides rise to the level of the top of the milldam weir at Dumfries.

The rise of the tides has been carefully measured at Carsethorn, Glencaple quay, Kingholm quay, and Dumfries, and the measurements are referred to one datum line. The section shows the depth of silt and gravel that requires to be removed to give a low-water navigation of 8 feet up to Dumfries.

The datum line is 60 feet below the level of the top of the Kingholm quay. The point from which it is taken is not marked farther than it is taken from the top of the coping stones of that quay, which is all upon a level.

From the Milldam weir, which is the first obstruction to the navigation, to the mouth of the river, the distance is six miles six furlongs; and from the mouth of the river to Southerness the distance is about 15½ miles.

The first bridge is immediately above the Milldam weir.

The river is visited with very heavy land floods.

The harbour is governed by commissioners under the Act 51 Geo. III. cap. 147; their services are gratuitous.

At present there is no resident engineer. In 1811, the improvements of the river were laid out by Walter Newall, who conducted them for two or three years, and who has been the only engineer employed by the commissioners. From 1814 to 1836, the works upon the river were carried on by the commissioners. From 1836 to 1840 inclusive, the improvements were laid out and conducted by Walter Newall. Since that period, the convener of the commissioners has, with the aid of such commissioners as he has called to his assistance, conducted the works upon the river.

There is one pilot, who is considered sufficient for the traffic. The pilots undergo no examination, but are appointed by the Board.

There is one light at Southerness, which burns seal oil; it is under the management of the commissioners, and is maintained from the port dues. No light dues levied.

A light ship, near to the situation of the black buoy, would be of advantage to the navigation, and would add greatly to the safety of the shipping, if the traffic of the Solway could maintain it.

The amount of revenue from shore dues, in 1843, 1,043*l.*; 1844, 1,212*l.*; 1845, 1,434*l.*; 1846, 1,284*l.*

There is a debt due to the heirs of the late Mr. Greenshiels of 1,750*l.* The interest payable thereon is five per cent.; and a debt due to the Bank of Scotland, of 2,700*l.* Interest payable thereon is five per cent. Total debt, 4,450*l.*

The total amount empowered to be raised is 16,000*l.*

In the same years there have been expended, for improvements on the navigation, and keeping in repair the works along the river—year 1841, 1,106*l.*; 1842, 409*l.*; 1843, 473*l.*; 1844, 290*l.*; 1845, 284*l.*

There are no fishing smacks; but one very small trawler.

The fishing within the Solway might be very much extended with capital and enterprise.

There are no asylums nor endowments for decayed fishermen or seamen; but provision is made for seamen's widows and children, under the Act 4 & 5 Wm. IV., chap. 52.

Land can be had for docks or slips, if required; and there are good quarries of red sandstone suitable or building, at the distance of about three miles from Dumfries and from Glencaple. These quarries can furnish blocks of any size suitable for building wharfs or docks.

APPENDIX C.

DUMFRIES.

No. 466.
Answers to printed Queries.

The surface rock of the centre of the lower part of the valley of the Nith is red sandstone, and the surface rock of the side of the hills that bound the valley is old clay slate. The sandstone along the west side of the ridge that lies between the Nith and the Lochar is deeply overlaid with conglomerate. The diluvium over the sandstone is a compact tilly-clay filled with boulders. There are no coal-pits nor mines in the neighbourhood.

There is abundance of shingle within the channel of the river.

There is no life-boat, no rocket nor mortar, in case of wreck.

There is no Admiralty chart agent resident; nor any register kept of wind, weather, barometer, or wrecks; nor any tide scale within the port.

The only places of refuge in the neighbourhood are Carse-thorn, within the Solway; Gibshole, within the river Urr; Balcary bay, and the Ross of Kirkcudbright, within the mouth of the Dee.

The wrecks take place chiefly upon the Barnhourie sands. These wrecks have been chiefly strangers that had either lost their reckoning, or had been driven upon these banks by gales of wind.

The best point for a harbour of refuge is at the Ross of Kirkcudbright, within the mouth of the Dee.

There are no military defences of any sort for the harbour or the coast.

The works for the improvement of the navigation from the Irish sea to Dumfries would require to be such as would fix the line of the low-water channel through the *reach* of the Solway, between the mouth of the Nith and Southerness, according to the plan proposed by Walter Newall. This line of channel has been laid down with due regard to the surface rock formation upon both sides of the river and Solway. The surface rock upon both sides of the upper part of the navigable portion of the Nith is red sandstone; that upon the east side is deeply overlaid with conglomerate rock of a very compact formation. The lower part of the river runs between the red sandstone formation upon the east side, and that of the old clay slate upon the west side. The proposed line for the channel is laid down with the view that it may be improved so as to give a low-water navigation to Dumfries. If the line of the channel were fixed as shown by the plan, it would gradually be deepened by the influence of the currents, and if aided by artificial means, its progress in deepening would be very rapid, particularly between the mouth of the river and Arbigland; because, through that *reach*, the material to be removed is very light silt. The distance through this reach, from Airds point to Borran point, is about 9,600 yards. The east side of the channel only should be fixed.

WALTER NEWALL.

Dumfries, January 19, 1847.

No. 467.

Letter from R. MAXWELL WITHAM, Esq., *on the Improvements of the Harbour.*

No. 467.
Witham, on the Improvements of the Harbour.

Kirkconnell House, New Abbey, Dumfries, January 16, 1847.

IN consequence of various obstructions in the river Nith, such as shoals, sharp turnings and rocks, cargoes for Dumfries are often landed at Glencaple quay, distant about five miles from Dumfries; but from the bed of the channel being of a soft moveable sand, and from the general flow of the tide first striking on the projecting point of land on the eastern or Dumfries side, called Glenhowan Point, it has been forced in a north-westerly direction to the western shore, near Kirkconnell, by which it has formed a channel along that shore, and cut away the pasture or merse land to a great extent; then crossing over to the Dumfries side, a little above Glencaple pier, it leaves an extensive sandbank, which often prevents vessels from coming to or near that quay. Vessels are, therefore, frequently under the necessity of shipping and landing their cargoes at Kelton, distant three miles from Dumfries, where there is no other accommodation than the bare beach. At this place, spring tides flow about 12 feet.

From Kelton to Dumfries, there were formerly so many obstructions, and the water was so shallow, that few vessels, even of a small draft of water, ever ventured up so far as Dumfries, from fear of damage, or of being detained from want of water. Of late years, however, many rocks have been removed, and the channel has been so much deepened, that if vessels reach Kelton in safety, they now generally proceed to Dumfries. In fact, the chief difficulties of navigating the river Nith, now lie between Glencaple pier and the sea

It is the decided opinion of many seamen and intelligent persons, well acquainted with the river, some of whom have been born and bred on its banks, that if the channel could be narrowed before reaching Glencaple quay, in that part of the river opposite Kirkconnell, where the prevailing current of the tide has carried the channel out of its course, that there would be plenty of water at all times up to Dumfries for vessels navigating the river; and that opinion has been entertained beyond the memory of man. For with a view of securing the channel in its proper direction, the former proprietors of the Kirkconnell estate, now belonging to me, and extending for about three miles on the western shore, erected at some period which cannot now be ascertained, an extensive quay or jetty, extending about 100 yards into the river from high-water mark, which was repaired at great expense by the late James Maxwell, of Kirkconnell, Esq., under the advice of skilful engineers, among whom was Mr. Hollinsworth, in 1810. (See Appendix No. 459.) Mr. Maxwell's efforts to confine the river were so much approved of at the time, that power was given to him and to his successors, by Act of Parliament, to extend the jetty to within seventy yards of the opposite shore, where the channel of the river ought to be.

Competent judges, such as pilots, captains of merchant vessels, and of steamers, and others, are decidedly of opinion, that if the pier at Kirkconnell above referred to were extended, and the whole raised to a proper height, that the straightening and deepening of the river would be effected; and more especially so if a portion, indeed the whole of Glencaple pier were removed, and built along the shore, instead of projecting into the river as at present; for when the tide ebbs, the point of merse land on the Kirkconnell side, opposite Conheath House, (called Goodnenk Point,) turns the water on to the Glencaple pier, and that again turns it off in a south-westerly direction on to the Kirkconnell jetty, and so destroys the effect that jetty has in contracting the river by preventing the ebbing tide and fresh water from returning by its natural channel on the eastern side of the river.

The removal of Glencaple pier, and the lengthening of the Kirkconnell jetty, ought, therefore, I submit, to be brought under the notice of the Tidal Harbours Commissioners; and I trust they will

APPENDIX C.

DUMFRIES.

No. 467.
Witham, on the Improvement of the Harbour.

permit me to draw their attention thereto, with reference to any report they may make to Parliament on the state of this river; for by such measures the deep water channel between Glencaple and the sea, hitherto neglected, would be secured: the impediments in the navigation of the river Nith, which now discredit the country, and endanger the commerce of Dumfries would be removed, and a thriving trade with America and elsewhere would be greatly encouraged.

If the whole of Glencaple pier is not removed, much good might be done at little expense, by removing a portion of it, or by rebuilding it on piles, so that the water might pass under it; and by raising the present jetty at Kirkconnell, without adding to its length, a small jetty or two at other points on this property ,being also thrown out; and I should be happy to afford every facility to such undertakings.

I am, &c.,
R. MAXWELL WITHAM.

The Secretary to the Tidal Harbours Commission.

No. 468.

Return of Income and Expenditure for the Years 1841–2, 1842–3, 1843–4.

INCOME.										EXPENDITURE.									
Heads of Income.	1841-2			1842-3			1843-4			Heads of Expenditure.	1841-2			1842-3			1843-4		
	£.	s.	d.	£.	s.	d.	£.	s.	d.		£.	s.	d.	£.	s.	d.	£.	s.	d.
Tonnage dues upon vessels inwards. .	1,042	10	2	883	9	2½	987	7	8	Improvements and repairs, and light-house	408	18	11½	473	1	4½	289	13	2
Ditto ditto outwards .	206	17	9	143	1	7½	224	15	11	Salaries of officers . .	119	5	1	111	17	3	104	0	0
										Sundries	4	1	7	3	15	3	17	11	9½
										On account of debt and interest. . .	632	18	9	258	15	10	837	6	7¾
Total . . . £	1,249	7	11	1,026	10	10	1,212	3	7	Total . . £	1,165	4	4½	847	9	8½	1,248	11	7¼

Dues levied under Act 51, George III. Average tonnage, 52,608. Harbour dues at ½*d.*, 2*d.*, and 6*d.* per ton.

R. KNESLIE, *Clerk and Treasurer.*

Debt due on the 1st Jan., 1846, 5005*l.*

ANNAN.

ANNAN.

No. 469.

No. 469.
Return to Address July 29, 1844.

Return to Address of House of Commons of July 29, 1844.

Annan, December 4, 1844.

SIR,

IN answer to your letter of the 13th ult., respecting harbour dues, I am requested by Mr. R. Wightman to inform you that Annan is a free port, with the exception of a small toll collected for a quay, partly public and partly private property.

I am, &c.,
JNO. SAWYER.

Hon. H. Manners Sutton.

No. 470

Answers to printed Queries circulated by the Tidal Harbours Commission.

No. 470.
Answers to Printed Queries.

ANNAN Harbour is formed by the sea-reach of the river of the same name, which falls into the Solway Firth at a mile and a half below the town. A mill-dam dyke crosses the river about 100 yards below the bridge; half a mile farther down, the south-eastern bank is quayed for a short distance, and there are two pile jetties belonging to the steam-packet company at Annan Waterfoot. At this last-named spot the tide rises to 20 feet on springs, and makes itself felt at two miles above Annan Bridge; an equinoctial tide rises 22 feet; neap tides rise to 14 feet. A rocky bar of free-stone. 200 yards in extent, and rising one foot above the general bed, crosses the river just at its last bend towards the sea, at one mile from its outfall. The bed of the river has a fall of five feet in the last mile, so that there is only a depth of 10 feet water at the quay, and nine feet over the rocky bar, when there are 15 feet at its mouth. At half-flood, on all tides, vessels drawing 12 feet water can come up to the jetty at Waterfoot.

Annan is a free port, and no dues are levied; there is no engineer's report, nor any plan of the river, excepting the Admiralty Survey, by Captain Robinson, R.N., made in 1836. The English channel of the Solway, up to Waterfoot, is well lighted and buoyed; the light-vessel off Maryport shows a red light; at Lee Scar Point, two miles below Skinburness, is a bright light; at Cott, one mile above, on the shore of Silloth Bay, a red light; and at Barnkirk Point, or Annan Foot, is a tide light, shown at half flood. Some buoys might be placed with advantage at the entrance of the river.

The vessels belonging to the port are, 31 sailing vessels of 2345 tons; the arrivals were, 544 coasters of 57,550 tons; foreign, eight, of 1427, in 1845. Population of Annan, 5000. The railroad, connecting Carlisle and Dumfries, will cross the river by a fixed bridge, about 200 yards below Annan Bridge; and the town will shortly become the focus of four railways, and it is probable that much coke and coal will be brought by them for shipment at the port. Annan already exports for an extensive back country. The cattle shipped in 1846, to Liverpool, were 2000 head; sheep, 70,000 passengers, 27,000; and this trade has been yearly increasing.

SUPPLEMENT.

LEITH.

No. 471.

Report by John Rennie, Esq., F.R.S., *on* Mr. Chapman's *Plan for Improving Leith Harbour.*

No. 471.
Rennie, on Chapman's plan for improving the Harbour.

My Lord,

London, February 28, 1827.

I herewith beg leave to transmit, for your Lordship's information, the result of my late visit to Edinburgh and Leith, as regards the best mode of carrying into effect Mr. Chapman's proposed scheme for the improvement of the old harbour of Leith; and it is with great reluctance I beg leave to give my opinion as to the general propriety of the scheme, fearing that otherwise I may become, in some measure, responsible for its results. At the same time I respectfully trust that your Lordship will excuse me from any desire of intruding an opinion that may be uncalled for: but my late father having been so materially interested, I consider that I should not have acted candidly if I remained silent under the present circumstances. I will therefore proceed to state my objections as briefly as possible. They are as follow:—

1st. The small additional depth of water that will be obtained, and that only at the entrance.

2d. The liability of filling up, and the necessity of constant dredging.

3d. The expense compared with the advantage to be gained.

With regard to the first: the great objection to the port of Leith, in its present state, is the want of water sufficient to accommodate the increasing demands of the trade. At high water of neap tides there are only 14 feet, and at springs 17 feet on the bar; so that vessels drawing 13 feet 6 inches water cannot come up to the quays at all times, and when ready for sea, on account of the shoalness of the bar, they are detained in a similar manner. To obviate this serious evil, it is proposed to extend the east pier to the Mortella tower, a distance above 2,800 feet, and to run out a western pier, 1,400 feet long, from near the termination of the second dock, and by this means to confine the low-water channel, and scour away the bar, or rather remove it into deeper water, where the current may prevent it from being again deposited. That a certain depth of water, where the bar is now situated, would be gained, I am willing to admit; but I do not conceive that above 2 feet 6 inches will be gained by this means, while the depth of water at the tower would be the same as before.

With regard to the second: the western pier, it is true, would have the effect of tranquillising the space enclosed between the piers and the harbour upwards; but then the facility of deposit would be greatly increased, and in a short time, with the exception of the small river channel, the greater part of the space enclosed would be filled up, and must constantly be maintained clear by dredging at a heavy expense; and it happens, unfortunately, that this evil would be greatest in front of the proposed naval yard; and though this might be partially remedied by means of sluices from the docks, nevertheless it could not be done so effectually without a heavy expense.

With regard to the expense of this plan, its uncertainty renders it difficult to be calculated; but taking the length of the east pier as laid down, I should fear that it would not be done for less than 60,000*l.*, and the west pier, from 35,000*l.* to 40,000*l.*, besides the dredging apparatus, and 10,000*l.* for the boundary sea wall of the naval establishment, being in all nearly 120,000*l.*, besides the naval building, for the purpose of lowering the bar about 2 feet 6 inches, which, for such inconsiderable advantage, is certainly a very large sum.

The next and most important question naturally arises, What plan is most advisable for obtaining the desired object? and here it may be observed, that as the shore deepens towards Newhaven and westward, the current becomes stronger and the bottom cleaner, nature points out that the entrance should be extended in this direction, which would at once get rid of the water of Leith, its bar and deposit. The above has, I believe, been admitted by everybody, although the expense of the execution has deterred your Lordship from entertaining the idea; and certainly at this moment money cannot well be spared, and economy cannot be too strictly attended to. Nevertheless, upon considering the subject again, I think it will be found that the principal part of the late Mr. Rennie's plan may be obtained with a comparatively small expenditure. The grand object is to carry the entrance into deep water, in order that the largest class of vessels may enter or depart from the port at all tides; and to effect this I would propose, that instead of completing the third great basin according to the original plan, a ship canal, without quay walls, should be made in the same direction, with an entrance lock near where the late Mr. Rennie proposed to make the cross wall, dividing the dock from the harbour; from thence a harbour to be made, carrying out the entrance into about 8 or 10 feet at low water of spring-tides, which would give 28 feet at high water of spring-tides, and 22 feet at neap-tides; and would enable vessels of 200 tons to enter and go up to and depart from Leith at all times, and the largest class of vessels at about half flood. Moreover, they would always be able to get out and make their passage during the prevailing winds from the westward, which would be extremely difficult, and in some cases impossible, by the former plan of extending the present old pier. In carrying these works into effect, it would not be necessary to construct the whole of the walls of ashlar masonry, in which a large portion of the expense consists, with the exception of the entrance lock and pier heads. The remainder would be composed of rubble embankments, and where the canal is proposed, and lined with clay puddle, to keep in the water. The banks might be formed with earth and clay faced, and having the sea slopes only defended with stone: by this means the estimate would be materially reduced, and the whole might be accomplished for about 220,000*l.*; and for this the grand object, depth of water and shelter, free access and departure at all times would be obtained. It has been objected to this plan by some of the merchants of Leith, (but by no means the principal,) that such a measure would ruin the property of Leith; but in this opinion I do not agree, because a greater facility than ever would be given of bringing up ships to the town quays, and despatching them, when ready for sea, which, by extending the present piers, will not be accomplished. By extending the entrance towards Newhaven, as proposed, the distance from the entrance to Leith would be nearly the same; and the present docks

APPENDIX C.

SUPPLEMENT.

LEITH.

No. 471.
Rennie, on Chapman's plan for improving the Harbour.

would operate as a canal, and vessels belonging to the town would always be enabled to pass and repass them to their own warehouses without inconvenience. Moreover, the present entrance by the old piers would still be available also for the smaller class of vessels whenever the state of the bar would permit, and then there would be two entrances instead of one.

With regard to the naval establishment, the ground purchased some years since at Annfield would then be available, and a very complete dockyard, upon a small scale, might be made, capable of repairing frigates, or even larger vessels, upon an emergency, which will never, I fear, be the case with the present plan. It was observed that at Newhaven the water had shoaled considerably since the erection of the new landing pier. Upon this there existed some doubts; and when lately there, I made repeated inquiries, and found, that while on the west side the water had shoaled about two feet, on the east side there had been scarcely any perceptible alteration; for the state of the adjoining sand-banks depends so materially upon the prevalence of particular winds, that no correct conclusion can be drawn. Concerning the shoaling on the west side of the pier, this may be attributed to there being no western pier, as originally intended, to prevent the driving of the sand, which has a strong tendency from the westward. If the piers were to be extended properly seaward, I should apprehend no evil consequences from this. If, however, the present Leith piers are to be extended to the Mortella tower, according to the plan now resolved on, the water at Newhaven would no doubt diminish very rapidly, and the expense of constructing an entrance at Newhaven, if required at any time hereafter, would be materially increased, in consequence of its being necessary to carry it farther westward. Moreover, the entrance harbour would be able to accommodate steam-boats and the traffic of the ferries, for which advantages they would no doubt contribute. Indeed, I understand that above 30,000*l.* was about to be expended on their improvement, which, combined with the sum now about to be laid out, would make nearly 150,000*l.*, being only 70,000*l.* less than the other; the success of which would be certain, while that of the former will be problematical.

Upon the whole, therefore, viewing impartially all the circumstances of the case, I am decidedly of opinion that the best plan for the improvement of Leith Harbour would be to extend the entrance to the westward, according to the original design of the late Mr. Rennie, with the alterations above suggested; and I am further of opinion that it will ultimately be found most economical.

With the advantages of a good port, such as would be obtained by the measures above recommended, the trade of Leith might be carried to any extent; and the largest class of vessels now used in other ports would be accommodated here, and avoid all those delays and other inconveniences to which they are now subject, and which it is so anxiously desired by all to remove.

I have consulted my brother, Mr. George Rennie, upon the above, and he cordially approves of the whole. For the better illustration of the subject, I have made the accompanying plan, which will, I trust, be sufficiently explanatory.

I cannot conclude this Report without again apologizing to your Lordship for this interference; but being uncertain how far I might be considered responsible by the success of the present plan, and my late father having been so materially concerned in the other, I thought if I remained silent, it might be construed into acquiescence, which, in justice to his memory and myself, I thought it right to explain. Having said thus much, I trust I shall be excused; at the same time, I beg to observe, that in the event of Mr. Chapman's plan being continued, I shall use my utmost endeavour to have that portion under the direction of the Navy Board executed in the best, and at the same time the most economical manner, and be happy to render every assistance in my power to the other part of the scheme also, in order that the whole may be rendered complete; and in this I trust that my gloomy prognostications may not be realized.

I have, &c.,
JOHN RENNIE.

The Right Hon. Lord Viscount Melville, K. T.,
&c. &c. &c.

GENTLEMEN,

Admiralty, March 7, 1827

MR. RENNIE, on his return lately to London, addressed a letter to the Navy Board, with plans of the intended Eastern and Western Piers at Leith, and I have no doubt that the Navy Board, under the sanction of the Admiralty, will approve of his suggestions; I believe also that they have been acquiesced in by Mr. Chapman, and I presume that the plans will be forthwith transmitted to the Commissioner of the harbour and docks.

I think it right at the same time to acquaint you that Mr. Rennie has addressed a letter to me, of which I send herewith a copy, together with the plan which accompanied it for an entrance to the Leith Harbour from Newhaven, and I recommend to you to take the necessary steps for submitting those documents, with as little delay as may be practicable, to the Commissioners.

As far as the Naval department is concerned, I have no hesitation in expressing my decided preference in favour of Mr. Rennie's plan; and considering not only the greatly increased accommodation which would be afforded thereby to the naval service, but also the saving of expense in erecting the proposed western pier and the wharf walls of the naval yard, it would be an advantageous arrangement for the public to contribute largely towards the execution of Mr. Rennie's plan. As far also as regards the ferry Trustees, though they might not be able to afford anything approaching to the sum mentioned by Mr. Rennie, they might nevertheless be disposed to give material assistance.

When the improvement of Leith Harbour was suggested and urged a few years ago, I was one of those who, though with much reluctance, abandoned entirely, on account of its expense, any idea of carrying into effect the plan of the late Mr. Rennie for an entrance at Newhaven, more especially when there was brought forward at the same time a plan greatly inferior in point of expense, and not beyond the means that might without difficulty be provided for its execution. Now, however, the case is materially altered: the Newhaven plan is brought within a compass which ought to induce the Town Council of Edinburgh and the merchants and traders of Leith to make an effort for its accomplishment, and thereby improve the harbour to the greatest practicable extent; while the expense of the plan proposed by Mr. Chapman is raised so much as to render it very problematical, even if the money can be obtained, whether it will not greatly outweigh the very limited benefit which could be derived from that improvement. It must also be recollected, that independently of any difficulty in providing for the expense of the eastern pier, now so much increased beyond Mr. Chapman's estimate, the same difficulty will occur in regard to the western pier. When I undertook on behalf of the public to execute that portion of the work at the expense of the Naval department, it was on the footing of Mr. Chapman's estimate, and with reference to the benefit which we should derive from the exclusive use of the

APPENDIX C.

SUPPLEMENT.

LEITH.

No. 471.
Rennie, on Chapman's plan for improving the Harbour.

western pier, and from the shelter it would afford to the landing of boats from ships in the roads. Even if the expense beyond the original estimate had been double, it might have been submitted to; but now when we are told that we must be prepared to meet an expense five times as great as that estimate, I do not feel myself at liberty on behalf of the public to embark in any such undertaking. We are bound to perform what we have engaged to do, and to that extent I am willing to go, or even as already stated, to double the amount, but I cannot undertake what is now proposed. If, therefore, the western pier is to be erected on the plan recommended by Messrs. Rennie and Chapman, the excess beyond what the Navy ought reasonably to be called upon to contribute must be provided from other sources.

I have in the former part of this letter recommended to you to bring this whole matter as soon as possible under the consideration of the Commissioners, because if the plan of a canal from Newhaven is adopted, and Mr. Chapman's scheme to be abandoned, a new Act of Parliament will be necessary. On the other hand, if the latter plan is to be adhered to, immediate steps ought to be taken to supply the funds that will be required beyond the original estimates.

I am, &c.,
MELVILLE.

Captain Boswell, R. N.
Robert M'Nair, Esq.
John Day, Esq.

No. 2.

Report relative to the formation of a Harbour and Wet Dock at Trinity, on the South Side of the Frith of Forth, near Edinburgh, by THOMAS GRAINGER *and* JOHN MILLER, *London.*

No. 472.
Grainger and Miller, on a Harbour and Wet Dock at Trinity.

Edinburgh, January 1, 1835.

THE improvement of the harbour of Leith is a subject which has long and anxiously engaged the attention of the Lord Provost, Magistrates, and Council of the city of Edinburgh, to whom the sole direction of the affairs of that port was intrusted, prior to the establishment of the Leith Dock Commission in 1826, and in whom the management of its revenues is still invested. None of the attempted ameliorations of the town council, however, having proved of any permanent benefit, the matter has been taken up by the public; and various schemes have been brought forward, either for remedying the natural defects of the present harbour, or for supplying its deficiences, by the establishment of another in a more favourable situation. The undertaking which is the subject of this Report is regarded by some as likely to become a rival to the port of Leith, and by others (as we think with more justice), as a necessary appendage to it, which is loudly called for by the altered and still rapidly changing shipping trade of the country. Before entering upon the immediate object of this Report, it may not be out of place to consider, shortly, the additions and alterations which have been made at the port of Leith, since the beginning of the last century, and to inquire how far the advantages arising from them have been commensurate with the great sums which have been expended in their completion. About the year 1700, a general notion seems to have been entertained (and the same ideas are still but too prevalent), that the extension of the pier, and the erection of dams on the river near Leith Mills, would remedy every existing evil, and afford all the accommodation required. Accordingly, we find that, in 1710, a petition was presented to Queen Anne by the Magistrates and Council of Edinburgh, to obtain a survey of the harbour of Leith, and a grant of money for its improvement. In consequence of this petition, two members of the Navy Board, and three of the Trinity House of London, were sent to survey the shores and harbour on both sides of the Frith of Forth, but particularly the harbour of Leith, and the result was, a grant of 30,000*l.* for extending the two piers, and making a sluice above the bridge, by which it was expected that the depth of water on the bar, which then varied from 14 to 17 feet, would be increased to 20 feet.* Since that date, it is well known that, independent of the large sums which the docks have cost, the piers have been greatly extended, and other attempts to deepen and improve the harbour have been made, at a large expense, notwithstanding which, the depth of water on the bar is still considerably short of 20 feet, so that the whole money which has been laid out during the last century seems to have done very little good, and this is the more to be regretted, as it is now used as an argument against the formation of a harbour, in another situation better adapted to the wants and exigencies of the present state of trade.

In 1798, the magistrates and council of Edinburgh consulted the late Mr. Rennie, when he suggested the formation of a new entrance to the port, and gave a plan accordingly, in which he proposed to construct the two docks which have been executed, another nearly as large as them both, immediately to the westward, and an outer harbour with its entrance nearly opposite Newhaven, and about 230 yards to the eastward of Newhaven pier. It is understood that on the two docks, the only part of Mr. Rennie's plan which has been carried into effect, upwards of 300,000*l.* have been expended. The great expense of this part of the plan has prevented the execution of the remainder, and from the enormous debt for which Leith harbour and docks stand mortgaged, there seems not the least probability of its being ever carried farther. Considering all this expenditure, we might naturally expect to find Leith harbour one of the finest in the country; how much it is the reverse, every one knows; its deficiencies, however, are but the consequence of contending against insurmountable natural obstacles, and of overlooking or disregarding the general advantage of the trade and navigation of the country, for the purpose of benefiting or preserving some insignificant local interests.

But notwithstanding all the money which has been already fruitlessly expended, there are still many to be found who contend that there is nothing to prevent the present harbour of Leith being made suf-

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* Excerpt from minutes of Council of the City of Edinburgh, 30th August, 1710: "It is necessary, for preventing of mistake, to observe, that the Report made by those who were especially employed by the Lord High Admiral, takes notice, that the water, when they were there, did only rise above the bar of Leith fourteen foot; whereas, that Report from the Trinity House at Leith, subscribed by the whole members, bears, that the water rises fifteen, sixteen, and seventeen foot, both which are true; and the reason of the seeming difference is, because when the gentlemen who were sent from the Admiralitie, visited that harbour in May last (1710), when there had been, as it happens sometimes, a long tract of easterly winds, which had sent in a great deall of sand upon the bar, and which the carrying out of the peer, according to both opinions, will certainly occasion and raise the water to twenty foot, which, it's presumed, will be sufficient for the service of her Mat.tie's largest ships; and what use that may be to the Government is apparent." From the "Plan of the Harbour and Docks of Leith," dated 1831, made out by Messrs. Dall and Leslie, superintendent and resident engineer of the harbour and docks, it will be seen that the depth of water at high-water on the bar, at that date, was, at

	Ft.	In.
Average spring-tides	17	9
Average neap-tides	13	9
Average of all tides	15	3

No. 472.
Grainger and Miller, on a Harbour and Wet Dock at Trinity.

ficient for all the wants of the trade. To this subject we have given the fullest consideration, and we feel confident that we shall be able to show, by investigations and surveys made, not only by ourselves, but by almost every scientific engineer whose attention has been directed to it, that all has been done for Leith which can be done, consistently with that economy which is due to the shipping interest of the country.

We have already seen that the late Mr. Rennie condemned the present approach to Leith harbour, by proposing another near Newhaven; but, according to Dall and Leslie's chart, even the Newhaven entrance would not have been sufficient for the present trade, there being, at the spot which Mr. Rennie contemplated as the seaward termination of the piers, only one foot of water at low water, besides which, the ground in the offing is foul.

Subsequently, Mr. Chapman, engineer, was consulted, and according to his advice, the eastern pier was extended, and some other additional works were executed, which in all, we believe, cost somewhere about 28,000*l*. How far the advantages derived from these additions have been adequate to the expense, we shall leave to those connected with the harbour to determine.

In June 1828, the late Mr. Telford, by order of Government, inspected the harbour of Leith, when he recommended that a back-water pier should be constructed, with a range of beacons along the present entrance channel from the then pier-head, by doing which he evidently did not expect that the harbour would be very materially altered, but only, as he expresses it, that "it would render Leith as perfect as its localities admit of." In fact, Mr. Telford must have been satisfied that accommodation could not be obtained at Leith for steam-vessels at any moderate expense, for he recommends that a landing-place of masonry, 100 yards in length, should be constructed about 400 yards from the present pier-head of Newhaven, and connected by means of stone piers with a gangway of timber. This plan was estimated at upwards of 38,000*l*., but it was only intended as a landing-place, and not as a harbour, within which steam-vessels, or others of a large class, could lie in safety.

The possibility of improving Leith harbour has been frequently considered by Mr. Stevenson, civil engineer, and in his report, relative to a proposed harbour at Granton, he says, "That the original attraction to Leith, as the port, was evidently the outfall of the river of that name; but the extensive flat which covers the entrance to the harbour seems to render abortive every effort for its improvement. In order to obtain a depth of 12 feet water at low water, spring-tides, the piers at Leith would require to be extended about a mile seaward of high-water mark. The inconvenience which would attend communicating with vessels at the low-water extremities of such extensive piers, together with the difficulties, and in certain states of the weather, the impossibility of hauling vessels along them, as well as the expense of executing works of that magnitude, render the improvement of the entrance to Leith harbour a very hopeless undertaking." Mr. Stevenson, accordingly, proposes that, instead of improving Leith harbour, an entirely new one should be made at Granton, of which we shall hereafter take notice.

In September last, Mr. Cubitt, civil engineer, London (by the direction of Government), made a survey of the south shore of the Frith of Forth, between Leith and Granton, and he also concurs with the eminent engineers who preceded him in thinking that the accommodation which the trade of the port requires cannot be obtained by improvements on the harbour, and recommends that a new entrance should be made immediately to the east of Newhaven pier, and almost precisely opposite the place recommended by Mr. Rennie for that purpose thirty-six years ago.

Still more recently a plan and report have been published by Mr. Anderson, civil engineer, who says, in reference to this subject, "It is matter of public notoriety that the port of Leith can never, from its present entrance, be more than merely a tidal harbour," and that "the situation of the pier and natural causes combine to preclude the possibility of its ever being made a low-water harbour by the present channel. It may, indeed, be possible, at an enormous expense, to extend the pier seaward to the deep channel of the Forth, but no artificial means can overcome the natural obstacles, either by deepening the channel of the river Leith along the pier, or keeping its course free. The immense shoal of sand, which extends over a space of nearly five miles from Newhaven pier to the east of Portobello, and reaches seaward beyond the Martello tower, is continually shifting, and would soon fill up any excavation of the channel of the river Leith. That river itself, besides, in time of flood, continually brings down a great quantity of alluvial soil which accumulates and is deposited at its junction with the waters of the Frith, thus forming a bar across the channel and fairway of the harbour, which it is impossible for any works of art to prevent or remove."

It is hardly necessary to bring forward any more evidence to show that low-water accommodation cannot be obtained at Leith: nevertheless, we cannot but advert to an excellent letter, addressed by Captain J. D. Boswall, R.N., to the proprietors of steam-boats connected with the Frith of Forth, in which he says, "If a low-water pier could be had at Leith, it would be of the utmost importance to that port, and add greatly to its prosperity, by admitting steam-vessels, as well as sailing packets, ferry-boats, and pinnaces, to arrive and depart at all times of the tide. This, however, cannot be accomplished, and Leith harbour must for ever remain a dry one, until sufficient funds can be collected for carrying the present extension of the east pier beyond the bar into deep water, as nature has thrown difficulties in the way of constructing low-water piers there, except at the enormous expense which it must necessarily require to carry them into the deep channel of the Frith.

Here, then, is a list of scientific men, who, however they may differ in some points, yet all agree in this, that low-water accommodation cannot be had at Leith, and that, although such vast sums of money have been expended, no material increase in the depth of water has been obtained since the reign of Queen Anne. No one can doubt that if we wish to maintain even our present trade, low-water accommodation must be immediately provided, more especially if Edinburgh and its vicinity are to become the seat of manufactures.

Mr. Cubitt, in his report states, "That the trade of the port is done by means of vessels, the average of the whole of which is under 80 tons, I believe nine-tenths of the whole under 100 tons." The reason is obvious. The harbour will not admit of larger vessels, and until a harbour fit for the reception of such be provided, no material change could be expected. But what is the fact? In spite of every disadvantage, numerous steam-vessels of the largest class are now employed in the Leith and London and north of Scotland trade, although goods and passengers are in all weathers exposed to the dangers and inconvenience of open boats, and the vessels themselves (among which there are some of the finest perhaps in the world) must anchor in the roads, without any shelter, except what is afforded by Inchkeith. Only two of the large class steam-vessels are brought into Leith harbour, (and these take the ground at every tide, and are unable to sail except at nearly high water.) None of the others have any connexion with Leith, but make what use they can either of the Trinity Chain-pier or Newhaven Pier, and even the ferry steam-boats are frequently, from want of water, prevented from landing their passengers at Newhaven Pier.

No. 472.
Grainger and Miller, on a Harbour and Wet Dock at Trinity.

While all admit the propriety, or rather the necessity, of some remedy to the evils attending the harbour of Leith, and of procuring sufficient accommodation somewhere in the vicinity of Edinburgh, yet there is considerable diversity of opinion as to the most eligible situation for the new works. In February last a plan and report of a harbour at Trinity were prepared by us. Since then various other projects have been brought forward, and very considerable discussion on the subject has taken place, but we are still convinced that Trinity is decidedly the best situation for constructing a harbour capable of affording all the accomodation for an extensive trade in the vicinity of Leith. The only alteration which we would now propose on our original plan, is a reduction of the extent of the accommodation, by which the expense will also be considerably reduced. While we do this, we are still satisfied that the plan now submitted will give sufficient accommodation, not only for the existing trade, but for a very considerable increase. In our former Report we stated our conviction that Trinity was the best situation for the harbour. It may be said that, having been professionally engaged in preparing plans for a harbour at Trinity, it becomes our duty to support that situation; but to this we would answer, that having farther examined the coast, with the whole plans which have been submitted by others to the public, and maturely considered the subject in all its bearings, we are perfectly convinced that, all circumstances taken into account, Trinity is decidedly the best situation. Referring to the map of the coast, which accompanies this Report, it will be seen that a sand-bank begins near Musselburgh, and terminates to the west of Leith Harbour and near Newhaven Pier, a distance of upwards of six miles; and that another commences to the eastward of Caroline Park, and terminates about the Hound Point, near Queensferry, a distance of upwards of four miles, leaving a clear space or bay, free from sand, at the bottom of which Trinity Chain-pier and the site of the proposed harbour are situated. The situation is therefore away from the sand-bank, and the bottom being generally composed of firm blue clay, is admirably adapted for the construction of extensive and durable works. But besides deep-water is as close to the shore at Trinity, if not closer, than at any other place between the two sand-banks, and there is no foul ground near it. Leith roads too are almost right off, but rather to the east; and the south channel, where there is excellent anchorage, is broader off Trinity than at the immediate roads, and a vessel has abundance of sea-room between the anchorage ground there and the dangerous flats at the head of the south channel near Cramond and the Mickry Isles. The proposed harbour is within 2,200 yards of the Custom-house, or the lower drawbridge, which may perhaps be taken as the centre of Leith, with which a direct communication can easily be formed by means of a perfectly level road, (or railway, should such be found requisite,) at a very trifling expense. As regards Leith, the warehouses and places of business would be brought as near to the same depth of water as they could be by the extension of the present pier. As regards Edinburgh, assuming the Register-office, as being nearly the centre of business, Trinity is almost as near as Leith, and if the south end of the Earthen Mound be taken, it is quite as near, a straight line being measured between the points; but, by the existing roads, the shore at Trinity is the nearest to the Earthen Mound. As a ferry station we consider Trinity to be the best which can be obtained on the south side of the Frith, considering depth of water, with the vicinity to Edinburgh, Leith, and the populous country to the east. These are the principal reasons for the adoption of Trinity as a situation for a harbour, and we are confident that, upon full investigation, they will be found satisfactory to every candid inquirer.

In proposing a harbour for the accommodation of large vessels, we consider a wet dock, in which they can be always kept afloat, essentially necessary, as every one must be aware how much it strains a heavy vessel when it is allowed to ground, especially steam-vessels of the larger classes. What we propose, therefore (referring to the annexed plan), is to construct a wet dock, containing 18½ acres, and affording inner wharfage to the extent of 3,540 feet, and in such a form as will admit of the construction of jetties, so as to allow the extent of wharfage to be increased, should trade at any future period render such additional accommodation necessary. The dock to be entered by a double gate lock, 250 feet in length by 60 feet in width, which is of sufficient dimensions for the admission of a ship of the line, or a steam-vessel of the very largest class.* The double gates admit the passage of vessels at all times, when there is sufficient water on the outside to float them, and which at low water of spring-tides will not be less than 10 feet, and of neap-tides about 14 feet. The entrance will be protected by a substantially-built break-water, 1,200 feet long, founded in 11 feet water at the lowest ebb of spring-tides, and which, with two check piers built upon arches, each 270 feet long, will secure an outer harbour 710 feet long by 500 feet wide. The points of the breakwater will project 200 feet on either side beyond the points of the check piers, and it will be constructed in such a manner as to admit of vessels being laid along its inside wall. Within this harbour, and on the east side of the lock, it is proposed to construct a low-water landing-slip or inclined plane, by which passengers, cattle, carriages, or any kind of merchandize, could be landed or embarked with the greatest facility, at all times of the tide. The quay, in which the landing-slip is made, to be 324 feet long, and a quay of the same extent on the west side of the lock, which, with the check piers, will give every accommodation and facility for the landing or discharging the cargoes of steam-vessels of even the largest class, while those which may have to wait their time of sailing can be drawn up along the breakwater or anchored within the harbour. For the accommodation of the ferry steam-vessels and others, which are confined more to the passenger trade of the Frith, it is proposed to have landing-places on the outside of the harbour, by which means they will be enabled to run as readily out and in as they can do now at the Chain-pier, with the additional advantage of being completely sheltered by taking the eastern or western side, so as to suit the weather in the Frith. It is proposed to make the two piers, which form the east and west sides of the dock, 90 feet wide, to admit of a wall being built on either for enclosing the dock and its wharf ground; the interior wharf grounds on either side of the basin or dock to be 50 feet broad, leaving a width of 36 feet on the outside of the walls for the purpose of forming a carriage-way and footpath for the use of the trade of the outer harbour. By this means the trade of the dock and harbour may be kept perfectly distinct, and at the same time each will be sufficiently accommodated. In the construction of the dock it is proposed that the south or land side should be carried out to about the low-water mark, leaving a clear space of ground 380 feet broad, as store ground; and again, between the dock and the outer harbour, it is proposed to leave a space of ground 350 feet broad, for the purpose of affording room for a coal yard, and for what other accommodation may be required for the trade of the outer harbour. It is also proposed to erect two lighthouses, with cranes and other conveniences.

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[*] The entrance lock of the Earl Grey Dock at Dundee, which was opened a few weeks ago, and which admits the Dundee and London steam-ships, is 210 feet long and 55 feet wide. These ships measure 50½ feet over the paddle-boxes, 180 feet from inside of sternhead and taffrail, 192 over taffrail and figurehead, and 240 feet over jib-boom and gaffend.

APPENDIX C.

SUPPLEMENT.

LEITH.

No. 472.
Grainger and Miller, on a Harbour and Wet Dock at Trinity.

From soundings carefully taken by us, and which agree very nearly with those marked on Dall and Leslie's excellent chart of the coast adjoining Leith, we find that there will be a natural depth of water in the outer harbour at the lowest ebb of spring-tides (and which is assumed, as in Dall and Leslie's chart, at one foot nine inches below the level of the sill of the docks at Leith,) varying from 10 feet at the dock gates to 11 feet 1 inch at the side next the breakwater. It is proposed that the wet dock should be excavated, so as to give it the same as the natural depth at the gates, which is 10 feet under low-water mark. The average rise of spring-tides is 18 feet 6 inches, so that in the outer harbour there will be a depth of water at high water from 28 feet 6 inches on the one side to 29 feet 7 inches on the other, while in the dock there will be 28 feet 6 inches, a depth sufficient not only for every trading purpose, but for the largest of His Majesty's ships frequenting the Northern Seas.

Having now described the nature of the works which we propose should be constructed at Trinity, we have next to point out some of the advantages which the proposed plan will have over any other yet laid before the public. Those who have paid any attention to the construction of harbours will have found that there are two great objects to be attended to; the one is to obtain sufficient shelter, the other is to prevent silting; but it often happens that while there has been great care in attaining the former, the latter has been overlooked, and indeed, in many cases, what has been done to provide a sufficient shelter turns out to be the very means for promoting the silting, and this is especially the case when harbours are constructed in a tide-way. Having these two objects distinctly in view in making out the plans of the proposed harbour at Trinity, we flatter ourselves that we have succeeded in arriving at a plan which will be found not only to give sufficient shelter, but that, though in a tide-way, the water will rather have a tendency to deepen than to silt up. To say nothing of the expense, we have great objection to obtain depth by dredging where it can be obtained otherwise, as it very seldom happens that the dredged depth can be preserved, except by continual recurrence to the same means. A dredged depth may be maintained without much trouble when the trough which is dredged is parallel or nearly so to the run of the tide, or it may even be maintained, though less likely, when the trough is across the tide-way, provided the tide be allowed to sweep on without the least interruption; but it must be evident that in the trough there must be still water, and wherever this is the case, silting must to a greater or less degree take place. On reference to the plan, it will be observed that the outer harbour, which of course is open to the flux and reflux of the sea, is laid down so as to be parallel to the run of the tide, and the check piers being built upon arches, the stream either way will flow through it without the slightest interruption. As the run of the water between the shore and the check piers will be obstructed, it will naturally proceed along the sides of the dock, inclining towards the outer harbour, and the openings of the check piers (being the first outlets), will have a tendency to increase the current through the harbour, and consequently to increase the depth of water. That this will be the effect we think is so evident as scarcely to need proof; but if any were required, the additional depth which has been gained at the Trinity Chain-pier, in circumstances nearly similar to those which we are now supposing, would be sufficient for our purpose. Before the construction of that pier, we understand that the depth of water at the spot where it now terminates was, as it is still, a little farther out, five feet four inches, but in consequence of the slight interruption which the piles at the head have given to the fair run of the tide, and by causing it to flow past their sides with a certain increased rapidity, the water has deepened to six feet eight inches, being an increase of one foot four inches. We would have been satisfied could we have shown that the depth had not been lessened, but it is still more satisfactory to find that it has increased.

We have been at great pains in preparing an estimate of the whole of the foregoing works; and in this, as well as in the planning of the harbour, we have had the aid of the experience of Mr. Gibb, civil engineer, so well known as the most eminent contractor in this country, and who assisted Mr. Telford, when employed by Government, in 1828, in making the survey for the improvement of Leith harbour, and the Mid Lothian and Fife Ferries. The amount of the whole is 179,729*l.*, making large allowances for contingencies. It is unnecessary to give the details here, but we consider it proper to state, that they have been prepared with the view of being laid before a Committee of the House of Commons, where, as a matter of course, they will undergo the strictest scrutiny. We may also mention that the estimates have been made up, calculating on the works being done in the most approved manner; all the walls, both outer and inner, being of substantial masonry, of sufficient strength to resist the action of the heaviest seas. The breakwater is in like manner of the strongest formation, and we have admitted no stone casings or clay nucleus into any part of the works.

Having now described the proposed works, we shall, before concluding this Report, shortly inquire into the comparative merits of the different plans which have been submitted to the public.

The first in order is that of the late Mr. Rennie, which, however well it might have been adapted to the state of the trade at the time when it was proposed, when steam-vessels were unknown, is by no means suited to it at present, and we therefore consider it needless to do more than allude to it.

The late Mr. Telford comes next in order, and he seems to have considered Leith as hopeless; he, however, recommended that the Newhaven pier should be extended as a landing-place for a ferry station, but in doing so, did not contemplate the formation of an extensive harbour. In a Report to the Commissioners of His Majesty's Woods and Forests, dated 12th April last, after pointing out Newhaven and Burntisland as the points most advantageously situated on the Frith for steam-boat landings, he states, in regard to Trinity, that from its being "adjacent to Newhaven," it "will be sufficiently convenient as a landing-place to connect with Burntisland."

Mr. Cubitt, in September last, gave a plan and report, which we formerly noticed. Mr. Cubitt, in order to make Leith Docks available, proposes "to include all the space between the western dock and Newhaven pier with dry rubble stone breakwaters, or piers, as shown in the plans, with an entrance between them, at a depth of 12 feet low-water spring tides; and within the space thus included to excavate and dredge out a channel from 12 to 15 feet deep below low-water, and of sufficient width for the largest steam-vessels to leave or pass. By this simple means will a harbour be formed, in which accommodation will be made for all the ferry packets and London trade, in the most economical manner possible."

We find that the accommodation which Mr. Cubitt proposes to afford, assuming all the data on which he proceeds to be perfectly correct, is obtained by the simple means of spending 125,000*l.*, but this he states in rather a hesitating manner, as there is something said about its costing 150,000*l.* But without pointing out the many inaccuracies in the calculations upon which this estimate is founded, we are of opinion that his estimated prices are too low; for instance, for dredging hard blue clay under low-water, he calculates on 1*s.* per cubic yard; now, it is well known to all who know anything about

No. 472.
Grainger and Miller, on a Harbour and Wet Dock at Trinity.

such works, that it cannot be done at this rate, and that 2*s*. 6*d*, is much nearer the price which should have been assumed. There are nearly 450,000 cubic yards of this stuff, which would of itself increase the estimate upwards of 33,000*l*. But admitting that his estimate is correct, we think we can show that he has promised more than could be realised. We have laid down the position of his entrance on the chart prepared by Messrs. Dall and Leslie, "the accuracy of which," says Mr. Cubitt, "I had many opportunities of proving," and we find that at the spot in question, instead of a depth of 12 feet, as he states, there are only 9 feet. Within this entrance he speaks of dredging out a channel from 12 to 15 feet deep, as if 3 feet were very material, and as if a 15 feet channel would not cost considerably more than a 12 feet one; but let this channel be either the one depth or the other, we would ask what is its use, when vessels cannot get into it, the entrance being only 9 feet? He has, therefore, even admitting the whole of his assumed data and calculation, only obtained a channel leading to Leith docks with 9 feet water, so that at low-water every vessel of any considerable burthen in it will be aground; and to what does this channel lead? Why, it leads to Leith docks, in which there is at average spring tides only 16 feet 9 inches water, and at average neap tides 12 feet 9 inches, (supposing that the height of the water in the docks were always the same as that of the previous tide.) Mr. Cubitt's plan will, therefore, do little for the better accommodation of the shipping, and if executed, will only form one of those temporary but expensive expedients, which have already proved so hurtful to the commercial as well as the pecuniary interests of the city of Edinburgh. We object to the principle on which he proposes to execute these works, and we believe that we are borne out by almost every one who has examined the subject, when we say that they would not be of sufficient strength to resist the action of the sea. We also entertain strong objections to Mr. Cubitt's plan, not only on account of the want of breakwaters to shelter the entrance from the northerly winds, but from the impossibility of maintaining the depth even of 9 feet, without the constant and expensive application of dredging machines; as, from the construction of the harbour, with a low sand bank near its entrance, every tide will cause an influx and deposition of sand and mud, more especially during easterly winds, so prevalent in this neighbourhood. In a word, if we were called upon to give a design for reclaiming that part of the shore, and forming it into dry ground, as we believe a portion of it was about a century ago, we are persuaded that we could not have recommended anything more suited for the purpose than the breakwater proposed by Mr. Cubitt. We consider it unnecessary to go further into Mr. Cubitt's plan, than generally to remark, that a good harbour cannot be obtained at the same expense off Newhaven pier, or to the east of it, as it can be at Trinity, because the ground off Newhaven pier, and between it and Leith, is shallow and foul, and we believe it is understood that the late Mr. Rennie, on that account, considered the Newhaven pier as a failure. At Mr. Cubitt's proposed entrance, the water is very shallow, and a depth of 10 feet cannot be obtained nearer the shore than 770 yards, while on the west of the pier the ground is clear, and the same depth of water can be got within 580 yards of the shore.

Before taking leave of Mr. Cubitt's report, we have to notice the unfair comparison in the expense, which he was pleased to make between his proposed works and ours. The estimated expense of Trinity amounted to 250,000*l*., including the purchase of the shore ground, and all parliamentary and other expenses. This Mr. Cubitt put down at 300,000*l*. He indeed states the reason to be, that we have not included warehouses, approaches, roads, railways, &c.; but we would be glad to know how Mr. Cubitt would have us to calculate on the expense of either approaches or roads, as those leading to Trinity are already excellent, and why he would have railways necessary for the completion of our plan, when he does not require them for his own? Warehouses we certainly had not; but what was to be done with 50,000*l*. worth of warehouses, such premises not being now in quite the same repute as they used to be, when the means of conveyance were more tardy and uncertain? We believe the whole steam-boat trade of the Frith, is at this moment carried on without warehouses, or, if they do exist, it is to a trifling extent. We confined ourselves, therefore, to 250,000*l*., and for that there would have been a wet-dock of 42 acres, with a depth of 28 feet, affording an inner wharf of an excellent and durable description, to the extent of 12,000 feet, and an outer harbour with 11 feet of natural depth of water at the lowest ebb of spring-tides, completely sheltered from all winds, and accessible at all times, and capable of maintaining, if not increasing its depth—a circumstance of great importance to the success of such an undertaking.

Mr. Cubitt's estimate, on the other hand, amounted to 125,000*l*. or 150,000*l*. without any allowance for Act of Parliament or expenses of management; and for this, as we have shown, there could only be obtained a channel leading to Leith docks, of 9 feet water, liable to be silted up, or, if kept clean, only at a very heavy expense; and three timber wharfs, at which no vessel of any great burden could lie without being aground at every tide. Between the two plans, therefore, there could be no comparison. We are now inclined to think that ours was, perhaps, too extensive for the immediate probable trade; and we, therefore, have diminished it, maintaining at the same time all the general principles we at first laid down, and being satisfied that the superior accommodation which it affords will be obtained at a sum almost as low as that which Mr. Cubitt states for his, and certainly for much less than what it would actually cost.

In November last, Mr. Anderson published his plan for the improvement of Leith, and report thereon. Mr. Anderson proposes to make a steam-vessel harbour immediately west of Newhaven, by means of extending a pier out from that of Newhaven, but in a more westerly direction, to a natural depth of 10 feet water, forming, as it were, the east covering of the harbour, and by a breakwater stretching from the shore, and forming the west covering. In this breakwater there are to be six arches, the whole of which give a water-way of 200 feet. From this harbour a wet dock or canal is to extend to Leith docks, with an entrance-lock 170 feet by 60 feet. Mr. Anderson's proposed pier-head is on the same parallel with the eastern entrance to the proposed Trinity harbour, the entrance to Trinity harbour being in deeper water, and consequently a little farther out. We have read Mr. Anderson's report with much pleasure, and are glad to find that his opinions, in many points, coincide with our own. To his plan, however, we have precisely the same objections which we have to Mr. Cubitt's, viz., that it would not maintain its depth without constant dredging. Mr. Anderson imagines that the arched water-way in the breakwater will, by admitting the receding tide, scour out the harbour through its entrance. Now we feel confident that the receding tide will have no such effect. The arched water-way and entrance are nearly on the same parallel, and only distant from each other about 800 feet, so that the force of the current will be precisely the same, or nearly so, at both places, and consequently the water in the harbour will be at a stand still, beyond the ordinary rising and falling of the tide. By his own showing, the ebb tide passes close along the south shore; this being the case, it is obvious that the position which he proposes to give to his eastern pier will have the effect of checking the stuff carried by the receding tide, and of conducting it into the harbour. Admitting, however, that there would be a current through the harbour in the way in which Mr. Anderson imagines, the dredged channel which he proposes being below the natural channel, the current could not reach it, so that, supposing the natural depth of water might be maintained in the harbour, which we do not imagine would be the case, the artificial depth could not be maintained; on this account, therefore, we consider Mr. Anderson's plan defective, and not capable of affording the necessary accommodation. On going over Mr Anderson's estimate of the work, we find that his prices are much below those contemplated by us. We shall be glad to find that he is right, for if the work can be done so cheaply at Newhaven, it can be equally so at Trinity; we would not, however, peril our parliamentary estimates at such low rates. The same kind of work which he estimated at 6*d*. per yard (the excavation of the canal), we reckon at 1*s*. 6*d*., this would increase a sum which Mr. Anderson states at 7,020*l*. to 21,060*l*.; again, we may compare the price of his wharf walls; he calculates these at 9*s*. per cubic yard; we, on the other hand, taking the average of the rubble and ashlar, calculate ours at about double that sum; this would increase a sum which Mr. Anderson states at 11,664*l*. to 23 328*l*. We might compare other parts of his estimate with ours, but we think we have brought forward enough to show that either Mr. Anderson is too low with his prices, or we are too high with ours. As to Mr. Anderson's proposed steam-boat harbour, he seems to have overlooked the fact, that a great portion of it would be situated above low-water mark; or if he intended to obtain the necessary depth by dredging, he has omitted, so far as we can see, to include the expense in the estimates.

Messrs. Stevenson and Son, in December last, published their plan of a harbour at Granton, with their report thereon. They propose constructing a deep-water harbour and wet docks upon two scales The first and largest (represented by dotted lines on the annexed plan), is a harbour to contain 35 acres, with an entrance in 12 feet water, and two wet docks, each 6½ acres; the estimated cost amounts to 268,903*l*; the second (represented by full lines), is a harbour to contain 11 acres, with an entrance in 8 feet 9 inches water, and one wet dock of 6½ acres, and is estimated at 120,000*l*. The former of these scales is, like our original design for Trinity, somewhat too large, and it has accordingly been modified; to the modified plan we have now to advert.

With regard to the situation, which is described by Messrs. Stevenson as the most eligible, because (among other reasons) deep water is to be found nearer shore at Granton than at any other point between that and Leith,* we deny the fact assumed. In measuring on Messrs. Stevenson's plan, the distance from high-water mark to 12 feet 4 inches and 8 feet 9 inches, the depths of the entrance of the two scales of harbours respectively, we find that they correspond so nearly, that we may almost say they are the same with the distances from high-water mark, to the same depths off Trinity Chain Pier, as measured on Dall and Leslie's chart, which was carefully verified by us. The distances are certainly greater when measured on Messrs. Stevenson's plan, but without disparaging their plan, we are more inclined to take our own soundings, seeing that they so nearly correspond with Messrs Dall and Leslie's, and are rather less than those taken by Captain Thomas, admiralty surveyor, who was engaged for several years in surveying the Frith of Forth, for the purpose of constructing an official chart, and who, in written answers given by him, dated Deptford, 7th April, 1834, to written questions put by permission of the hydrographer of the Admiralty, relative to the proposed harbour at Trinity, states, "The soundings taken by Dall and Leslie are a few inches less than were found by me when surveying the spot (Trinity.)" It thus appears that Granton is not better in respect to deeper water than Trinity. We cannot but notice the manner in which Messrs. Stevenson make their comparisons in taking notice of the depths of water at several places along the coast. They couple Newhaven and Trinity as the same; now the distance to deep water off Newhaven Pier is much greater than it is off Trinity Chain Pier. Messrs. Stevenson find that Granton is more eligible on account of landward facilities. But we must state how Messrs. Stevenson arrive at this conclusion They fix on the Earthen Mound (at Princes-street, we presume) as the centre of Edinburgh; we have no objection to this point, but at the same time it cannot be held as the centre of the city in a business point of view. It is well known that the North Bridge forms the chief connection between the Old and New Towns, and that the Mound, on account of its steepness, is used principally as an approach to the courts, and by foot passengers; and that, if there is a point to be laid down as equally convenient to both the Old and New Towns, the Register-office must be held to be that point. Having assumed the Earthen Mound as the central point of Edinburgh, they state that their proposed harbour at Granton is 130 yards nearer to it than Trinity. This certainly appeared to us very extraordinary; and consequently led us to inquire how the fact stood, and in order to give Messrs. Stevenson every advantage, we made use of their own map. To arrive at this difference in favour of Granton, Messrs Stevenson have assumed a new road (running parallel for half its distance, and within 800 feet of the present excellent road by Inverleith Row to Trinity), from their harbour to the bottom of Pitt-street, passing through valuable grounds, not even allowing the Horticultural Garden to escape. They further imagine a new bridge over the water of Leith. They then proceed with their comparison, taking the present road from Trinity, leaving out of view, that if new roads are to be assumed as made, the same mode of calculation must be applied to Trinity, or any other spot, as well as Granton; but we have no hesitation in saying, that a few hundred pounds would make the present road to Trinity nearly a straight line. In comparison, therefore, let us reduce all the subjects of comparison to the same standard. By a straight line from Pitt-street Toll-bar, (which is a point on the road common both to Granton and Trinity, assuming the Earthen Mound as the central point of Edinburgh), to the proposed harbour at Granton, the distance is 3,033 yards, and to Trinity 2,390 yards, making a difference in favour of Trinity of 643 yards. Again, taking the distance by the present roads, the distance between Granton Harbour and the Toll-bar, and between Trinity and the Toll-bar, is 1,300 yards in favour of Trinity. As regards the connection with Leith, the proposed Trinity Harbour is 1,556 nearer than the proposed Granton Harbour.

With regard to Granton as a ferry station, which, in Messrs. Stevenson's report, is classed among the land facilities, the nearer a ferry station is to the population which it is to accommodate, we should think, *cæteris paribus*, the better. Now, if this is admitted, Granton is not only not the best situation, but is the worst of all places proposed. Besides having the opinion of the late Mr. Telford in

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* We have to state, that the datum of Messrs. Stevenson's soundings is different from ours and that adopted by Messrs. Dall and Leslie. Messrs. Stevenson have adopted the sill of Leith Docks, whereas we, as well as Messrs. Dall and Leslie, have assumed a level 1 foot 9 inches below the sill of the dock, owing to its being nearer a very low tide; consequently Messrs. Stevenson show a greater depth of water than we do; but in order to bring them to the same datum, 1 foot 9 inches will require to be taken off all Messrs. Stevenson's soundings; the depth 12 feet 4 inches no Messrs. Stevenson's plan, is equal to no more than 10 feet 7 inches on our or Messrs. Dall and Leslie's plan.

APPENDIX C.

SUPPLEMENT.

LEITH.

No. 472.
Grainger and Miller, on a Harbour and Wet Dock at Trinity.

favour of Trinity as a ferry station, we have shown that it is nearer than Granton to Edinburgh and Leith. Beyond all question it is a great deal nearer, and consequently much more convenient to all the thickly inhabited country to the east of Leith. The distance between the entrance of the harbour at Granton and Burntisland, the nearest ferry station on the north side of the Frith to Granton, is only 100 yards less than between Burntisland and Trinity. But Burntisland is not the most important station on the north side of the Frith; in 1832, there were only 20,036 passengers between Newhaven and Burntisland, while there were 60,968 between Newhaven and Pittycur and Kirkaldy. Measuring the distance, therefore, from Pittycur to Granton and Trinity, the difference in favour of the latter is 570 yards. So inconvenient would Granton be as a ferry station for Leith, and the populous district along the shore, by Portobello, Fisherrow, and Musselburgh, that the passengers from those places would be much more likely to take the ferry at Leith, even with the certainty of being much longer upon the passage, than travel half the distance between Cramond and Leith before going on board.

As to the lines of railroad proposed by Messrs. Stevenson, it appears to us that they cannot be regarded as part of the project, as no provision is made in the estimate for their execution. Besides, Granton holds out no advantage in this respect, as a railway may be made as easily from Trinity to the Union Canal as from Granton, and certainly much more easily to Leith.

But farther, we entertain a decided objection to Granton, because it rests upon the eastern extremity of the Drum Sands, a sand-bank, as we have already noticed, which stretches from the Hound Point, near the Queensferry, to the situation chosen by Mr. Stevenson. On reference to a chart of a portion of the Frith of Forth, attached to this Report, as well as to that attached to the Report of Messrs. Stevenson and Son, it will be seen, that the northern verge of this bank extends from the Hound Point past the northern extremity of Cramond Island, Birnie Rock, and two other rocks, situated at a very short distance to the west of the proposed harbour. That these promontories and rocks guide the current which defines the extremity of this sand-bank, we think there can be no doubt whatever, and that if they had been farther seaward, the bank must also have extended farther. This bank is understood to have increased several hundred feet during the last 20 years, and can it for one moment be doubted that, if the works proposed by Messrs. Stevenson were executed, it would immediately extend to them, and thereby obstruct, if not entirely close the harbour itself? We have many instances of similar results, particularly on the east coast of England; and see what has taken place at Newhaven since the erection of the piers in 1812. At that time, it is said, "there was six feet clear depth of water at the lowest ebb tides, which admitted the ferry-boats and pinnaces, and now there is only at its extremity, at low water ordinary spring-tides, about two feet six inches depth of water, and in very low tides, which happen about six or eight times in the year, it is always dry."* Here then at Newhaven we have an accumulation of about four feet of sand and mud in 23 years; and if such is the case there, what would it be at the projected works at Granton, which rest upon the great bank already described? It is also well known that the extension of Lieth Pier has had the effect of carrying out the south sands of Leith.

We also object to Granton, because it is farther removed from the anchorage ground of Leith Roads, than either Trinity or Newhaven. In reference to Captain Thomas's very accurate chart of the Frith of Forth (copy of a part of which is attached to this Report), it will be noticed that the place marked by him as the anchorage ground is on a line with Nelson's Monument, and the spire of North Leith church, where the words "Leith Roads" are placed. Now, on reference to the chart which accompanies Messrs. Stevenson's report, "Leith Roads" are delineated nearly one mile and a half farther west, where the south channel is only about one fourth the breadth of what it is known to be off Newhaven and Trinity.

To the Granton Harbour, we entertain other minor objections, such as the want of good, safe anchorage ground near it; its position in relation to Cramond Island, Mickry, Oxcar Bank, Inchcolm and other islands, but we think enough has been said to satisfy every candid inquirer, that it is a scheme which it would not be for the interest of the community to have executed.

In conclusion, we have only farther to observe, that we feel satisfied that we have proved:—

1. That the accommodation which the shipping interest of the country requires, is not to be obtained at the present harbour of Leith, and that if any material improvement is to be effected, or low-water piers erected, the site which ought to be chosen is at a short distance to the east or to the west of Newhaven. In support of this proposition, we have adduced the opinions of the late Messrs. Rennie and Telford, Messrs. Stevenson, Cubitt, and Anderson, as well as that of Captain D. Boswall, to these we may be permitted to add our own; and so far as we know, there are none of an opposite tendency.

2. We have also shown that the situation chosen by Mr. Rennie and Mr. Cubitt on the east of Newhaven is inferior to Trinity on the west, inasmuch as the ground in the offing is foul, and 10 feet water is much farther from the shore.

3. We have also shown that although the point of the pier proposed by Mr. Anderson is nearly in the same ground as the entrance to Trinity, yet it is a mere landing point, and that the work is under estimated. That the actual cost of making a wet dock or ship canal from Newhaven to Leith would be far beyond any advantages which could be obtained by forming a connexion with the present wet docks, which have neither space nor depth of water to recommend them. That the entrance-lock is too small for the first class of steam-ships,† and the design itself is objectionable, in so far as there is no provision made for protecting the entrance of the harbour, and no natural means provided for scouring either the harbour or its entrance. Besides, so far as we can judge from the estimates, there is no sufficient depth in the harbour for steam-vessels.

With respect to the proposed Granton Harbour, we have shown that it is decidedly inferior to Trinity,—

1. As a ferry station.

2. That it is farther removed from the business part, or the centre of Edinburgh, and that it is much farther from Leith.

3. That it involves a great extent of expensive new roads, some of which are not provided for in the estimate.

4. That ten feet water is not obtained nearer the shore than at Trinity.

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* Captain D. Boswall's Letter to the Steam-boat Proprietors of the Frith.

† The lock proposed by Mr. Anderson is only 170 feet long. The 'Monarch' steam-ship, in the Leith and London trade, is 206 feet long, and there is scarcely one of the first-class steam-ships but what is more than 170 feet long.

APPENDIX C.

SUPPLEMENT.

LEITH.

No. 472.
Grainger and Miller, on a Harbour and Wet Dock at Trinity.

5. That the modified plan only affords a depth of seven feet water at its entrance.

6. That it is farther removed from anchorage ground, particularly that of Leith Roads.

7. That it is situated upon the extremity of an extensive and extending sand-bank, which bank could not fail to extend itself to the harbour, as soon as the works shall be projected into the current.

In farther support and illustration of our views and opinions on this subject, we beg to refer to the documents, of which copies are printed in the Appendix.

THOMAS GRAINGER,
JOHN MILLER.

J. Gina, Esq., *Civil Engineer, to* Messrs. GRAINGER *and* MILLER.

DEAR SIRS, *Aberdeen, January* 17, 1835.

I HAVE perused with much attention your "Report relative to the formation of a harbour and wet dock at Trinity," and have carefully considered your designs for the proposed works, and I have entered minutely into the draft of the details of your estimate for the execution of the same.

I have also fully considered and compared with your designs the various other schemes which have been from time to time proposed, either to remedy the present very defective state of Leith Harbour (the evident unfitness of which to afford accommodation for the description of trade so imperiously demanded, is now sufficiently admitted by all persons concerned in its commercial transactions), or to provide proper accommodation for its trade as near the present situation as is practicable.

Notwithstanding that of late years great exertions have been made, and large sums have been expended by Government, as well as by the incorporation of Edinburgh, under the direction of some of the most eminent engineers in the kingdom, the beneficial effects anticipated have not been realised. More recently, schemes by Mr. Anderson and Mr. Cubitt have been laid before the public; as they, however, vary but little in their general principles from some of those contemplated very many years ago for resuscitating this forlorn hope, it would be needless for me, after the very full exposition contained in your report, farther to enlarge on them; or on that of the new harbour proposed by Messrs. Stevenson and Son, at Caroline Park, which is a most inconvenient station in every point of view, being upwards of two miles to the west of Leith.

Under all circumstances, therefore, I have no hesitation in giving the preference to your scheme, especially as it would possess the following important advantages, viz.—

Facility of entrance and departure.

Complete protection.

Deep water at all times of tide.

Great accommodation both in the outer harbour and wet dock.

Ample means for a proper classification of trade of every description.

And, from the construction of the two entrances, the most efficient natural powers of not only maintaining but increasing the depth of the water.

Likewise a very superior station for the ferry steam vessels.

I am of opinion that your estimate is quite sufficient for the execution of every part of the works proposed by you, and should have no hesitation to undertake the works for the sum therein stated.

I am, &c.,
JN. GIBB.

To Messrs. Grainger & Miller,
Civil Engineers, Edinburgh.

EYEMOUTH.

EYEMOUTH.

No. 473.
Number of Boats, Fishermen, &c., belonging to the District, 1846.

No. 473.

Eyemouth District.—Boats and Fishermen, &c.

Office for the Herring Fishery, Eyemouth, May 14, 1847.

An Account of the Number of Boats, whether decked or undecked, belonging to the district of of Eyemouth, that have been employed in the year ending January 5, 1847, in the Shore Curing Herring, Cod, and Ling Fisheries, distinguishing the Number of Fishermen and Boys by whom the same were manned; and showing also the Number of Coopers employed; the Number of Persons employed in gutting, packing, re-packing, cleaning, or drying the fish; the Number of Labourers employed; and the Total Number of all such Persons, together with the Number of Fish-curers in the district:—

Divisions of District.	Number of Boats employed.	Number of Fishermen and Boys by whom they were Manned.	Number of Coopers employed.	Number of Persons employed in Packing, Cleaning, or Drying the Fish.	Number of Labourers employed.	Total number of all such Persons employed.	Number of Fish-curers.
Eyemouth	48	227	24	124	26	401	10
Berwick and Greenses .	34	170	12	42	6	230	3
Burnmouth and Ross . .	29	145	5	34	4	188	3
Coldingham	20	104	2	20	4	130	2
Cove	7	37	2	12	2	53	1
Dunbar	28	140	13	78	7	238	7
Totals . . .	166	823	58	310	49	1240	26

I do hereby certify, that the above account is true, to the best of my knowledge and belief.

JOHN COUPER, *Officer of the Fishery.*

EYEMOUTH.

No. 474.
Income and Expenditure, 1837-46.

No. 474.

Abstract of Income and Expenditure of Eyemouth Harbour from 1837 *to* 1846.

Years.	Receipts.			Expenditure.						—
				General.			For Deepening			
	£.	s.	d.	£.	s.	d.	£.	s.	d.	
1837	117	19	0½	21	5	1	39	9	2	
1838	124	2	9	61	6	8	95	0	6	
1839	190	1	2	549	13	9	88	0	0	
1840	282	8	11½	106	1	10	81	10	0	
1841	226	9	7½	40	2	3	52	12	6	
1842	239	2	9	119	5	11	136	13	0	
1843	209	15	11	1397	16	8	2	2	10	
1844	273	15	0	1147	15	4	27	3	11	
1845	500	13	8½	460	18	3	522	11	11	Deepening.
1846	281	17	10½	317	2	0	4221	7	9	General expenses.
Totals £	2446	6	9½	..			4743	19	8	

GRANTON.

GRANTON.

No. 475.
Stevenson and Son, on a Harbour at Granton, Frith of Forth.

No. 475.

Report of Messrs. ROBERT STEVENSON and SON, *on a Harbour at Granton, Frith of Forth.*

Edinburgh, May 22, 1834.

THE reporters had lately the honour of addressing some preliminary observations to your Grace, about the progress of their survey of the coast at your Grace's estate of Granton, or Caroline Park, about two miles westward from Leith. Having now completed that survey, they are enabled to report, as follows, regarding the establishment of a deep-water harbour at Granton, and the works necessary for effecting this important national object.

At the outset they may remark, that the public utility of establishing a good rendezvous for the shipping of the Eastern coast of Britain, will readily be acknowledged by all who are acquainted with the nature of the harbours on that coast, which are chiefly dry at low water, and depend entirely on the rise of the tide, for the admission of vessels of large burden. Many of these harbours, too, are connected with rivers of difficult access, such as the Thames, the Humber, the Tyne, the Tay and the Dee; and are therefore but ill calculated for the reception of ships driven to seek shelter on a lee shore. The want of a harbour, which can be taken at all times of the tide, is severely felt along the whole range of coast from the Orkney Islands to the Straits of Dover; and fatal accidents have frequently occurred from the danger and uncertainty which attend the navigation of vessels seeking shelter, during heavy gales, in channels of difficult access. Ships overtaken by gales from the N.E.E. and S.E., cannot run with safety for any place on the Eastern coast, except the Friths of Forth and Cromarty, and every facility which is afforded to the navigation of these estuaries, and the shelter of the shipping which frequent them, become objects of the greatest importance. On these grounds, therefore, among others, your Grace's attention has been directed to the formation of a deep-water harbour at Granton, as a place of safety for the shipping of the Frith of Forth, which, since the erection of the Bell Rock lighthouse, is so easy of access as to have become the great rendezvous of the North Sea fleets, both of His Majesty's Navy and the merchant service, especially in time of war.

But there are other grounds of a public nature on which this measure may claim your Grace's favourable attention. The foreign and coasting trade of Scotland would be highly benefited by the establishment of a deep-water harbour, so near the city of Edinburgh, the prosperity of which is at present much depressed by the state of the entrance to Leith harbour. The original attraction to Leith, as the port, was evidently the outfall of the river of that name, but the extensive flat which covers the entrance to the harbour, seems to render abortive every effort for its improvement. In order to obtain a depth of 12 feet at low-water of spring-tides, the piers at Leith would require to be extended about a mile seaward of high-water mark. The inconvenience which would attend communicating with vessels at the low-water extremities of such extensive piers, together with the difficulties, and, in certain states of the weather, the impossibility of hauling vessels along them, as well as the expense of executing works of that magnitude, render the improvement of the entrance to Leith harbour a very hopeless undertaking.

There can be little doubt, that these inconveniences form a serious obstacle to the traffic of this district, and the present low state of the foreign trade of Leith, is naturally to be traced to the want of deep water accommodation for shipping. The trade, which at one time supplied the western coast with Baltic produce through that port, has, in a great measure, been transferred to other harbours; and one of the chief objects in the formation of the Forth and Clyde canal, which was to establish a trade between the opposite Friths, has been frustrated, in so far as regards the interests of the merchants of Edinburgh, by the inconveniences which ships experience in frequenting Leith harbour.

The present inquiry regarding a deep-water harbour for the city of Edinburgh, has, however, more directly originated in the great inconvenience, and even hazard, which arise from the transhipment of goods and passengers to and from steam-packets, and other vessels, which are obliged, from want of deep-water accommodation at Leith or Newhaven, to lie at anchor in the Roads, and to load and discharge their cargoes and land their passengers in open boats. This inconvenience is so generally felt and acknowledged, that it is needless to enlarge upon the necessity of forming a deep-water harbour for Edinburgh, a measure which, sooner or later, is certain to be carried into effect.

Such are the advantages which would be derived from the establishment of a deep-water harbour near Edinburgh; and the reporters now proceed to state, that, after a careful survey of the coast, they are satisfied that no situation presents itself on the southern shores of the Frith of Forth, so suitable for the site of such a harbour as the small bay, about three quarters of a mile in width, formed between Granton Point on the west, and Wardie Point on the east. The depth which can be obtained near

APPENDIX C.

SUPPLEMENT.

GRANTON.

No. 475.
Stevenson and Son, on a Harbour at Granton, Frith of Forth.

the high water mark is greater here than at any other point between it and Leith; while its nearness to the city of Edinburgh, and the favourable levels of the intermediate country for the establishment of communication by roads and railways, clearly point out Granton as the most eligible situation.

These advantages will be seen, first, by comparing the extent to which it would be necessary to carry out piers at different points, on the shores between Leith and Granton, in order to obtain a depth of 12 feet at low-water of spring-tides; for it may be assumed that this depth would be required in order to give ample accommodation to the largest class of vessels. Measuring, then, from high-water mark, the reporters find, that to obtain such a depth at Leith harbour, piers would require to be extended seaward about 1500 yards, and at Newhaven or Trinity 730 yards; but to the westward of Wardie Burn, in the situation of the proposed piers at Granton, a depth of 12 feet at low-water of spring tides is found at the distance of only 550 yards from high-water mark. There cannot therefore, be any doubt, that at Granton a deep-water harbour can be established more easily than at any other point on the shore between it and Leith. Secondly, upon inquiring into the landward facilities of Granton, the reporters find, that, from the Earthen Mound, (taken as a central point in Edinburgh,) to high-water mark at the site of the proposed harbour, the distance, by the road laid down in the plan which accompanies this Report, is only about 26 yards greater than to high-water mark at Leith; while the present road from the Mound to the chain pier at Trinity is about 130 yards longer. Granton is also more conveniently situated for the ferry to the opposite coast of Fife, across which not fewer than 140,000 persons pass annually; its distance from Burntisland being only 4¾ miles; while from the stone pier at Newhaven to the same place, the distance is 5½ miles. It will likewise be seen that very convenient communications with Leith and its branch of the Dalkeith Railway, as well as with the Union canal, can be made from Granton by means of the lines of railway laid down in the plan. Thirdly, the nature of the ground at Granton is also favourable; for the beach consists of coarse gravel, with some patches of rock, which admit of being easily removed where they do not become the foundation of the projected piers. By boring the soil seaward of low-water mark on the site of the proposed harbour, the reporters have also ascertained that the bottom consists of mud and clay, which extends to the offing, where there is a depth of water of from 5 to 7 fathoms, affording excellent anchorage at a convenient distance from the entrance of the proposed harbour. Fourthly, the small bay formed by the points of Granton and Wardie, though somewhat exposed to the swell from the north-east, occupies a comparatively inland position, and is covered by the shelter of the island of Inchkeith, which so much breaks the force of the sea, that a harbour in this situation will possess all the advantages of still water, without the danger of being silted up to a greater extent than could be easily cleared by ordinary means. In all these particulars, the reporters are satisfied that Granton is peculiarly eligible as the site of a deep-water harbour *.

The superiority of Granton has, indeed, been long acknowledged; and it is believed that, about forty years since, the principal merchants of Leith foreseeing that the depth of water could not be easily increased in their harbour, applied to his Grace Henry Duke of Buccleuch, for his consent to the formation of a deep-water harbour on the shores of Granton, as a place of accommodation for their foreign trade and larger class of vessels. Though the immediate wishes of the inhabitants of Leith may perhaps now be hostile to such a measure; yet it appears from the extensive sand bank at the entrance of Leith harbour, that nature has placed an almost insuperable barrier to its improvement. If, therefore, any extensive trade is to be preserved to the town of Leith and its vicinity, and if the immediate interests of the inhabitants of the city of Edinburgh are to be consulted, it is obvious that a harbour on a more extended scale is necessary. There can be no doubt Granton is the site most suited for accommodating the trade of a prosperous district; and the transfer of part of the foreign trade and steam traffic to this harbour, would not place the merchants of Leith at a more inconvenient distance from their shipping, than the merchants of London, and of other ports of magnitude in the United Kingdom. The late eminent Mr. Rennie saw the great difficulty of access to the harbour of Leith, owing to the extensive sand banks which encumber its entrance, and was properly led to place the approach to that harbour at Newhaven. But to complete his plan quay walls would still be required to the extent of about 900 yards towards Newhaven, where deep water piers must be extended 730 yards seaward, making in all, a length of no less than 1630 lineal yards of expensive sea wall, before a depth of 12 feet is obtained at low-water of spring-tides. Such extensive works could not of course be executed, but at an expense much greater than would be required at Granton.

The works for obtaining a deep-water harbour at Granton are delineated on the accompanying Chart of the Frith of Forth, between Queensferry and Inchkeith, which shows the line of coast on either side, and the relative position of the proposed Granton harbour and Leith Roads. On the southern shore some of the soundings are marked in a fractional form; and the figures occupying the place of the numerator show the depth at high water, while those in the place of the denominator indicate it at low-water. These soundings were determined in reference to the state of the tide, as ascertained by an accurate register, kept at a tide gauge on the chain pier, and the position of each sounding was fixed by sextant observations. The other depths marked on the plan were not ascertained by the reporters, but are taken from the best authorities. All the soundings are marked in feet and inches, and refer to an ordinary spring tide, the low-water level of which corresponds with that of the Leith dock sill.

The coast more immediately connected with Granton is laid down from a trigonometrical survey, and shows the position of the proposed harbour, in reference to the city of Edinburgh, and its various approaches from the north, together with two new lines of road from the harbour to the city delineated in red colour. The eastern line of road crosses the water of Leith by a bridge immediately above the village of Canonmills, and that to the westward crosses by another bridge at or near the village of Water of Leith. It is intended that this latter road shall terminate at the Union canal, a little to the west of Port Hopetoun, and it is calculated, at any future time, to be converted into a railway for connecting the canal with the sea; an improvement which has long since been contemplated by the reporters, with a view to improve the interests of that navigation. In the course of that survey, two sunk rocks have been discovered off Newhaven pier, and are laid down on this plan. They have only 6 feet 9 inches, and 7 feet 6 inches water upon them respectively, at low-water of ordinary spring-tides; and are not to be found in any other chart of the coast.

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* After this Report had been communicated to his Grace the Duke of Buccleuch, the detailed plans and estimates were submitted to the consideration of the late eminent Mr. Telford, whose favourable opinion of the proposed measure must have been very satisfactory to his Grace.

APPENDIX C.

SUPPLEMENT.

GRANTON.

No. 475.
Stevenson and Son, on a Harbour at Granton, Frith of Forth.

For the purpose of converting the bay at Granton into a deep-water harbour, it is proposed to extend two piers of masonry, one from Granton Point, and the other from Ox Craig, a little to the west of Wardie Burn, in the direction shown in the plan. These two piers, at the distance of 666 yards from the shore, form an entrance of 150 feet wide, and 12 feet deep at low water, and 28½ feet at high water of spring-tides. This entrance would therefore be capable of receiving His Majesty's ships of war, and the largest class of merchant vessels. The area inclosed by these piers extends to 47 acres, and would be occupied partly as an outward harbour, or receiving basin, and partly as a suite of wet docks, fit at high-water of neap-tides for the reception of vessels drawing 18 feet water.

The reporters would propose to build the eastern pier in the first instance. With this view, it has been laid down with kants in such directions as to render this single pier effective for the shelter of ships, and more especially of steam-vessels, in moderate weather. The western pier would fall to be executed next; and lastly, the dock walls running between the roots of the two piers. By this arrangement, each progressive step of the operation would afford deep-water accommodation to shipping; and even without the addition of the wet docks, the berthage of vessels would be provided for in a manner hitherto unknown on the eastern coast of Great Britain, so that the largest merchant ships could enter the harbour in low spring tides after an hour's flood; while the London steamers and the ordinary class of ships might resort to it at all times of tide. The shipping accommodation at Granton may still farther be extended, for the purposes of a naval arsenal, if required.

It is not easy to arrive at certainty in estimating either the time or expense required for executing works of this nature in deep water. When it is considered, however, that the situation of the proposed piers, though extending into deep water, is a good deal sheltered, there seems to be reasonable ground for expecting that the progress of the works will not be unduly delayed by the disadvantages which generally attend operations of this kind. The favourable state, too, of the quarries already partially opened, by your Grace's command, in the immediate vicinity of Granton shore, induce the reporters to hope that no want of excellent building materials will be experienced in executing the proposed works; and the excavation of the docks may be so conducted, as to afford materials for the construction of the piers. Even supposing that unexpectedly the Granton quarries should fail, recourse may be had to Craigleith, which furnishes perhaps the best materials in the kingdom, and is only distant about two miles from the site of the proposed works. The reporters conceive that, with such facilities, the eastern pier will be executed in three or four working seasons, and the western pier in two or three seasons; so that the harbour works may be completed in about five or six years. The execution of the wet docks may either be carried on at the same time as the other works, or delayed till a future period.

The expense of the eastern pier, which extends to about 666 lineal yards in length, and terminates in a depth of 12 feet at low-water of spring tides, is estimated at 83,319*l.* 14*s.* 1*d*., and the western pier, which is of similar dimensions, is estimated to cost 81,468*l.* To these two sums, 104,118*l.* 2*s.* 8*d.* must be added for the expense of the wet docks; so that the amount for the whole harbour works, including 20 per cent. for incidents on the piers, and 10 per cent. on the docks, will be 268,905*l.* 16*s.* 9*d.*

The road which is projected to cross the water of Leith by a bridge at Canonmills, may be made nearly level as far as Pitt-street, with the exception of about 900 yards near Granton, which would rise at the rate of one perpendicular to 35 horizontal. It is not, however, proposed to carry this road at present beyond the point where it intersects the Queensferry road; and the estimate for executing it to this extent amounts to 5,237*l.* 15*s.* 4*d.*, independently of the price of land. The traffic from the Queensferry road would, in the first instance pass along the present road to Edinburgh by Canonmills bridge.

With regard to the line of road or railway by the village of water of Leith to the Union canal, there can be little doubt, from what has already been stated, that the proprietors of that navigation would feel a favourable interest in the execution of such a work. It is unnecessary, however, at this time, to do more than delineate on the plan its direction as surveyed, and to point it out as one of the facilities incident to Granton harbour. The same observations are applicable to a railway from Granton to Leith, which was also surveyed, and can be executed on one level.

To his Grace the Duke of Buccleuch
and Queensbery, &c. &c. &c.

ROBERT STEVENSON AND SON.*

RONALDSHA.

No. 476.

RONALDSHA.

No. 476.
Search, on the bad state of the Harbours in the Orkneys.

R. SEARCH, Esq., *Lloyd's Agent, on the neglected state of the Harbours in the Orkneys*, 1846.

THE roadstead and harbours of the Orkney Islands, which are extremely important as refuges to the Northern and Baltic trade of the kingdom, have been shamefully neglected. There are no local funds for their improvement, with the sole exception of the petty dues levied at Kirkwall, and the attention of Government has never been directed to them.

ROBERT SEARCH.

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* A committee of merchants and others interested in the establishment of a deep-water harbour near Edinburgh have, in a late Address to your Grace, expressed a desire to obtain a modification of the plan described in the foregoing Report, which they consider more than sufficient for the immediate wants of the trade. To meet these views, the plan No. 11, has been designed, and contains a limitation of the more extensive measure already proposed. This plan accordingly, shows the eastern pier carried into a depth of 8 feet 9 inches at low water; a work, the expense of which is estimated at 40,000*l.*, and which might be executed within eighteen months after the commencement of the operations. This single pier would be a great accommodation to shipping; and steamers of the largest class might approach it in most states of the tide. By the addition of a western pier, also shown in the plan No. 2., a basin of the area of 11 acres might be enclosed at an expense of 35,300*l.*; and, by completing the wall between these piers, a dock of 6½ acres in extent would be obtained for a farther outlay of 45,000*l.* Thus the whole of the works shown in the plan No. 2, might be completed for the sum of about 120,000*l.*

R. S. AND SON.

Edinburgh, December 3, 1834.

LERWICK.

No. 477.

No. 477.
Sutherland, on the state of the Harbour.

A. SUTHERLAND, Esq., *Lloyd's Agent, on the state of the Harbour.*

December 1, 1846.

As regards this port, it would be of much importance to the shipping interest if a harbour were built here, to which I respectfully beg leave to call the attention of the Commissioners appointed for this purpose. The natural harbour of Lerwick, commonly termed Brassay Sound, is the principal port in these islands. It has long been neglected, and which ought not to be the case, as it is a general resort for numbers of merchant vessels, and also for ships of Her Majesty's Navy when in the North Sea. It has frequently been intended by the inhabitants here to get a harbour built, but they could never raise funds adequate for such.

A. SUTHERLAND.

STROMNESS.

No. 478.

STROMNESS.

No. 478.
Hamilton, on the want of a Harbour at Stromness.

J. M. HAMILTON, Esq., *Lloyd's Agent, and Senior Magistrate, on the want of a Harbour at Stromness.*

October 14, 1846.

I REGRET that the Commissioners did not extend their visit to this and the other harbours in the Orkney Islands, particularly to Stromness and Long Hope, as both those places are of great importance to the mercantile as well as the Royal Navy of the kingdom, from being the resort of immense numbers of shipping, which are continually putting in, wind-bound, from almost all parts of the world.

The tidal harbour of Stromness is particularly important, as it is the only port north of Aberdeen where vessels can safely come to for repairs, in the event of receiving damage along the coast, or in passing through the Pentland Firth, there being one of Mortan's patent slips laid down capable of taking on vessels of five-hundred tons burthen. This safe and commodious harbour, I am sorry to say, is fast filling up, and in the course of a short time must be useless to vessels of large draft of water, in consequence of the whole dirt and rubbish of the place being constantly thrown into it by the inhabitants without the means of preventing their doing so, at least without the expensive process of interdict and other legal measures, which no one sees it his duty to adopt, although all admit the evil in its fullest extent.

Taking this case as a fair specimen of other harbours among these islands, to which may be added the inability of the existing authorities to prevent ballast being thrown or other obstructions being placed where fancy or caprice may point, I would therefore suggest that the Bill, about to be brought into Parliament, should contain a clause enacting that some local board be appointed, with power summarily to punish offenders; and this might be provided for in section 19, by distinctly stating and authorising certain parties to be named to act as conservators of tidal harbours within these several districts, with full power to detect and punish offenders.

[J. M. HAMILTON.

ISLAY.

No. 479.

ISLAY.

No. 479.
M'Lean, on throwing Ballast into the Harbour.

JOHN M'LEAN, Esq., *Lloyd's Agent, on throwing Ballast into the Harbour.*

October 9, 1846.

THE principal harbour in this island is Lochindaul, which is well known to be of the utmost importance as a safe place of refuge for the numerous vessels which frequent it when taking the North Channel on their outward and inward voyage from Clyde and Liverpool, and the other out-ports on the west of Ireland and foreign parts; but still I am sorry to say that it is very much neglected from want of a harbour, light, buoys, &c.

There being but very little trade carried on in this island, makes people careless in making application for getting the harbour improved, which, to say the least, stands very much in want of it,—in short I have seen vessels heaving their ballast out in the harbour and no notice taken of it; this I think should be put a stop to, by appointing a harbour-master, with full authority to prevent such a nefarious practice.

J. M'LEAN.

TOBERMORY.

No. 480.

TOBERMORY.

No. 480.
Campbell, on the want of Extension of the Quay.

DONALD CAMPBELL, Esq., *Lloyd's Agent, on the want of Extension of the Quay.*

October 2, 1846.

I BEG leave to call the attention of the Commissioners, or their engineer, in their extended survey, to the Quay at Tobermory, erected by the British Fishery Society, which requires an extension of at least twenty yards, to make it of benefit at all times of the tide, and also to the Harbour of Arynagom, in the island of Coll, which requires a quay to shelter the smacks and fishing boats, by which the cod and ling fisheries would be encouraged and extended.

D. CAMPBELL.

TARBERT.

No. 481.

Appendix C.

Supplement.

Tarbert.

No. 481.
Watt, on a Canal at Crinan and at Tarbert.

Report by James Watt, Esq., *on forming Canal communication between Loch Gilp and Loch Crinan, and between East and West Lochs Tarbert, addressed to the Commissioners of Highland Roads and Bridges.*

Glasgow, December 21, 1772.

I.—It having been considered as a desirable thing to open a more ready communication between the Firth of Clyde and the Atlantic Ocean. Though the general appearance of the lands that lie between this Firth and the ocean is very forbidding, yet nature has formed two places where such an attempt appears to be easily practicable. These places are, first, the isthmus of Tarbert, formed by the east and west lochs Tarbert, which approach very near to one another; secondly, the isthmus that lies between Loch Gilp, in the Firth of Clyde, and Loch Crinan, which communicates with the Western Ocean by the Sound of Jura.

II.—The advantages proposed to arise from such a communication are, first, the permitting the navigators of the Atlantic Ocean to enter into or go out of the Firth of Clyde when contrary winds or tides might prevent their passing the Mole or Promontory of Cantyre, for which the situation of Tarbert appears to be more particularly adapted; secondly, the permitting boats or other small vessels to come from the Western Isles in to Clyde in the winter season, which at present is exceedingly dangerous; for this end the situation of Crinan appears to offer the fairest.

III.—As this matter appeared to be of public concern, and, if practicable, a thing of great utility to the trade of the Firth of Clyde, particularly to the vessels coming from the North and West Highlands, whereby it might tend to the improvement of these countries, the Hon. Board of Annexed Estates, judging that it might merit a more particular examination than it had hitherto received, and having done me the honour to employ me for that purpose, they gave me the following instructions:—

IV.—1. That I should, in considering both the tracts for a canal at Crinan or at Tarbert, with the adjacent seas, islands, and coasts, lay before the board a plan of making a canal of 7 feet deep, and of 10 feet deep, and of such other depth as I should think most proper at both places, and an estimate of the expense.

2. An estimate of a *thorough* cut at Tarbert, and to report the height of the tides upon the east and west coasts, with other circumstances relating thereto.

3. To report the conveniences and inconveniences of the harbours at both ends of these canals, and of the access to them from the Western Ocean and Firth of Clyde.

4. The advantages and disadvantages attending both to vessels coming coastwise and through the Sound of Isla, from the difference of the length of the way, from the currents, and from other circumstances.

Query.—Whether coasting-vessels coming from the north do commonly pass by the Sound betwixt Islay and Jura, or betwixt Scarba and the mainland.

5. Pursuant to these instructions, in the month of July, 1771, I made a survey of both places, an account of which I proceed to deliver in the following pages:—

6. I begin by describing the Crinan passage, because some reasons of convenience made me survey it first, and proceed from thence to Tarbert, by the Sound of Jura.

7. It has been mentioned (1) that this tract lies across an isthmus, formed upon the south by the head of Loch Gilp, and upon the north by Loch Crinan. I shall first describe the immediate access to it on both sides, and then the isthmus or tract itself.

8. Loch Gilp is a branch of Loch Fyne, which is an arm of the Firth of Clyde, and is sufficiently wide and navigable for any kind of vessels. Its shores are mountainous, steep, and rocky, there being almost everywhere deep water close to the shore.

9. Loch Gilp is situated about 20 miles from the Point of Skipness, which forms the north side of the mouth of Loch Fyne; it is about two miles long, and scarcely one mile broad, even at the mouth. There are some small rocky islands in it, which afford shelter for vessels riding in the north side of them in four fathoms water. Its shores in general are rocky though shallow, but at its head it is free from rocks, and exceedingly shelving, the tide ebbing seven-eighths of a mile in ordinary spring tides. The shore there is a sandy gravel, covered with great quantities of mussels and cockles.

10. The rise and fall of spring tides in Loch Gilp is about 11 feet. I observed a neap tide that rose and fell about 9 feet; but I was informed that it ebbed nearly as low as is usual in spring tides, and as neap tides commonly fall as much short of the spring tides in the ebbing as in the flowing, I suppose their rise and fall to be about 7 feet.

11. From the low-water mark upon the shelving shore just mentioned (9), the loch deepens suddenly to 4 fathoms, which continues to the Rocky Island (9), situated about the middle of the length of the deep water of the loch, but nearest to the east shore. From this island to the mouth of Loch Gilp there is about 6 or 7 fathoms of water.

12. There is naturally no good landing-place near the head of this loch, but there are several places where, by the assistance of art, harbours may be made, where small vessels may lie or unload in safety, though they would lie aground at low water; and, indeed, if much navigation were to be carried on here, some such provision would absolutely be necessary, as the islands afford little shelter and the loch is exposed to the south winds.

13. The north-west side of the isthmus is formed by the inner bay of Crinan, which is an oblong basin about a mile in length, and excepting the channel of the water of Add, which I shall afterwards describe, it ebbs almost entirely dry every tide, though its shores are a shelving mud; yet upon the south-west side the rocks are high, steep, and rugged, almost to the high-water mark.

14. Upon the east and south sides it is bounded by a very level marshy plain of considerable extent, through which the water of Add, and a smaller *burn* which joins it, form winding channels.

15. Upon the north it is separated from the outer bay of Crinan by a rocky peninsula, which is called *the Crinan*, and gives its name to the whole. At the west end of the peninsula is the opening to the outer loch, or, more properly, bay of Crinan; this opening is about 200 yards wide, and has at high-water neap tides about 11 feet water; but, a little farther out in the bay, there is a bar formed by the tide, and the water of Add, on which there is only 8½ feet. Just within the point of the peninsula there is a convenient harbour for small vessels which is capable of great improvement.

16. The south-west shore of the outer bay is still more rocky and rugged than that of the inner one,

APPENDIX C.

SUPPLEMENT.

TARBERT.

No. 481.
Watt, on a Canal at Crinan and at Tarbert.

and it is hardly possible to scramble along betwixt the rocks and the water. The east shore is a shelving sandy beach, dry at half tide, and the north shore at Duntroon is steep rocks.

17. Upon the east side are two pretty large and high rocky islands, the passage to which is dry at low water.

18. This bay has a very wide opening to the north-west. It is sheltered from the ocean by the islands Scarba and Jura, which are very high land, and are about 10 or 12 miles distant. There is also a line of small rocky islands stretching from the Point of Cragnish, quite across the opening of Crinan, though at five or six miles distance.

19. Beside the two large islands (17) there is also a very small rocky one, which is never covered by the tide, and lies in the middle of the bay, having deep water round it. This is said to be the only rock in the bay which is dangerous for shipping, and may be easily seen and avoided.

20. The general depth of water in the bay is about 3 fathoms, until it approaches the low-water mark or the bar, where it suddenly shallows.

21. The tides in Crinan follow no known rule; sometimes ebbing and flowing several times in one tide, sometimes never ebbing at all, and at other times never flowing to any height. They seem to be more affected by the winds that blow in the ocean than by the changes of the moon.

I observed a neap tide that rose and fell 3 feet 6 inches, and a spring tide that rose 5 feet 3 inches above the low water of the neap tide. The neap tide continued about the point of low water nearly two hours, in which time it often flowed a little and ebbed again rather farther than it had risen. The times of high water of Crinan and Loch Gilp are said to differ greatly, at some times even to six hours; on the 20th July, 1771, I found them to coincide within an hour, the Crinan tide being latest.

22. Upon the south-west side of Crinan there is a small bay where vessels may ride in safety in four fathoms water.

23. There is good anchor-hold in fine sand through the whole loch, but from the wideness of its mouth and the distance of the lands that form its only shelter from that quarter, I am of opinion that it is by no means a safe harbour when the wind blows violently from the north and west. At such times vessels may take refuge in the harbour of Craignish, distant about six miles to the north, which being of a circular form, with a narrow mouth, affords good shelter from almost any wind, nor are there other harbours wanting in the neighbourhood which the sailor can run for when it is unsafe to remain in Crinan. But I leave this subject until I shall fix what appears to me to be a proper size of a canal for this situation, previous to which I must describe the isthmus, where it is proposed to pass.

24. The water of Gilp runs into the loch of that name, through the sands that are at its head, and forms its channel, sometimes in one part of them and sometimes in another. It runs at present close by the east shore. Gilp is a water of no great size, its channel in the sands being about 30 feet wide, but in the time of rains, like every water in this hilly country, it rises to a very great height, to which a smaller water, or rather burn, called Allnachulatright (which comes immediately from the mountains upon the east side of the valley), greatly contributes. This burn, from the great declivity of its channel, brings down large stones and gravel, which obstruct and turn aside the channel of Gilp, and it appears to have been the finer part of these depositions that has formed the sands at the head of the loch.

25. From the loch northwards lies an irregular plain, about the same breadth as the loch itself; the soil is various; where the water runs it is gravel; and towards the sides, where it begins to rise, it is rocky.

26. In about a mile the bottom of the valley has risen 27 feet above the high water of neap tides; and from a rocky mount, called Bad-dana-Cranavan, situated there near its middle, the valley, which had become somewhat more contracted, again extends its breadth, and becomes almost perfectly level, being a bog or moss of that kind that is formed of the detritus of acquatic plants. It is covered with grass, though in many places it is very wet, abounding with the *trefolium palustre*, sedges, and other plants of that genus. On the west side of this plain the hills are steep, rocky, and covered with brushwood; they are also intersected by some small rivulets; on the east they are more sloping, and partly arable.

27. The moss is somewhat more than a mile long, extending to an ancient tumulus called Cairnbaan, on which place the valley becomes rocky and very irregular. Its direction there is almost due east and west. The water of Gilp, which runs through the middle of the moss, and upon the east side of Bad-dana-Cranavan (26), has its channel at this place in a narrow bottom on the north side of the valley. The perpendicular height of the north-west end of the moss is about 33 feet above neap tides.

28. From Cairnbaan westward the glen in which Gilp runs is irregular, but at the narrowest is about 60 feet wide, of which the immediate channel of the water occupies about 15 feet. The bare rock is seen almost everywhere at the bottom of the water. On the north side of the glen are perpendicular rocks pretty high. The south side is somewhat less steep, and not so high, but it is also bare rocks.

29. Having followed up this glen about half a mile, the valley becomes open, and at Dunimuck Mill-dam is the summit or highest place between the two seas, which is elevated 70 feet above the high-water of neap tides in Gilp, and is near three miles distant from it.

30. At the summit the soil is a bed of gravel, which has been brought from the hills upon the south, and deposited by the waters of Gilp. I caused workmen to bore in this gravel to the depth of 18 feet, and had reason to believe it was much deeper, though it was so compact that it could not be pierced any deeper by boring-rods, and so full of water that the workmen could not get down by pitting. The descent from the summit towards Gilp is sudden, but towards Crinan it is very gentle for the first 600 yards, where it becomes more steep.

31. The bed of gravel at the summit does not extend far to the westward, but it is soon cut off by a boggy moss, on digging into which we found below it a bed of gravel, and then a muddy clay peculiar to the Highlands (being apparently a detritus of schistus). We bored into this clay much deeper than there will probably be occasion to dig, and found no bottom. This boggy matter, or mud, &c., seemed to be supported or kept in by a rising bank of gravel that extends across the west end of the plain, and rises a few feet higher than its general surface.

32. Near this place the valley is again contracted by two rocky mounts that proceed from the north side, and leave betwixt them and the hill of Dunardry, which is very high and exceedingly steep, only a narrow bottom of about 50 feet wide, part of which is occupied by the burn of Dunardry. The

APPENDIX C.

SUPPLEMENT.

TARBERT.

No. 481.
Watt, on a Canal at Crinan and at Tarbert.

perpendicular descent from the summit to this place is about 32 feet, the distance being somewhat more than half a mile.

33. The valley continues in this state, but growing gradually wider, till it passes the farm of Dunardry, near which it opens with an extensive mossy plain. The length of this contracted valley is about a quarter of a mile, and the perpendicular descent 24 feet.

34. The plain (14), which is a common morass, or flow moss (consisting principally of the water moss, or fog-rotted), extends about a mile to the confluence of the waters of Add and the Dunardry Burn at the high-water mark of the inner bay of Crinan. It is bounded on the south-west by the steep hill of Dunardry; upon the east by other mountains, about a mile and a half distant; and upon the north, by the outer bay of Crinan. Notwithstanding its being apparently level, it has a considerable declivity, the end near Dunardry being 14 feet above the high-water mark, and that next the sea only 4 feet above it. The mossy soil is of no great deepness, for at 3 feet under the surface a bed of clay appears to extend under the whole of it.

35. The water of Add is considerable, and larger than the Gilp; it comes with a winding channel through the moss, and continues through the sands of the inner bay of Crinan, being there, at shallowest, knee-deep at low-water mark.

36. By my levelling, the high water of spring tides in Crinan, is exactly upon a level with that of the neap tides in Gilp; the surface of the water of Add, when it enters the inner bay, being, at low-water, 4½ feet lower than the high-water mark, and having then 2 feet water, it follows that, in ordinary spring tides, there is 6½ feet water in that part of its channel, and in neap tides (21) only 4½ feet.

37. The whole distance from the summit to the high water of Crinan is one mile and three-fourths; and from the high-water mark of Gilp to the high-water mark of Crinan, four miles and three-fourths, the height of Dunimuck Mill-dam, which is the summit, being 70 feet.

38. Near Cairnbaan, a valley called Leichchluan, gives an opening to the north-east, by which the country may be crossed by a canal, independent of the passage by Dunimuck Mill. I thought it worthy of examination, and found that the summit of that passage was 11 feet lower than by Dunimuck, but that the summit itself was longer, that there appeared no easy way of bringing water to it, and that the passage that way must be more than a mile longer than the other. I shall therefore proceed in supposing the canal to be carried by Dunimuck passage.

39. My instructions recommended to me to give an estimate of a canal of 7 feet deep, and of a canal of 10 feet deep, with such other as I should think most proper. I shall first describe the canal of 7 feet, as that to which the depth of water on both sides is best adapted.

40. Beginning at Gilp, I propose to cut a new channel directly through the sands, as laid down in the plan, and to secure its sides by two jetties of rubble stone. The water of Gilp being turned into this channel, will contribute not only to keep it deep, but even to make it so.

41. The burn of Altnachulatright being the principal carrier of gravel, and the most unruly, I propose to throw it into the loch by a separate channel, to be cut for it somewhere near the New Inn.

42. Having brought a sufficient depth of water to the shore at the high-water mark, I propose immediately to lock up, by a lock of 6 feet rise above the ordinary neap tide, but capable of serving as a lock of 8 feet rise in a tide that should be 2 feet defective, as must often happen.

43. Having twice crossed the channel of Gilp, and proceeded a quarter of a mile from the first lock, I propose, at a gravel bank, to lock up again by another lock of 8 feet rise, then to proceed upon that level through Mr. Campbell of Askomill's policy so near Bad-dana-Cranavan (26), where the third lock may be founded upon the rock, or possibly cut out of it.

44. I propose to carry the canal upon the west side of this mount, in order to avoid the channel of Gilp and the north side of the mount, which is steep also, to save the founding a lock in the moss, which would be difficult. The canal must be here quarried out of the rock for some length, which is a blueish schistus, with nodules of quartz, is very hard cutting, and would rise in pretty large pieces.

45. From Bad-dana-Cranavan the canal may be carried upon a level through the bog to near Cairnbaan. At this place I propose a lock, and three more in the glen (28), leading to the summits. It will here be exceedingly expensive to dig the canal out of the solid, but it may easily be formed by dams across the valley, which has naturally little more width than what is necessary.

46. By means of seven locks the canal is now supposed to be raised 54 feet, and to be brought within 240 yards of the summit. I propose at this place to begin a piece of extra cutting, by which the height of the whole may be reduced 16 feet, and the canal continued on this level for 1,100 yards, where it again meets the present surface of the ground, and where it may begin to lock down. It is, perhaps, possible to cut a great deal more from the height of the summit without meeting with much rock, yet I am certain that some would be met with on the east side. The situation is exceedingly confined, and the earth would require to be removed to a considerable distance, for the boggy part would not bear any great load, and almost the whole earth will have to be laid upon the south side, because the hills come close in upon the north.

47. After the canal begins to descend, the locks must follow one another very fast in the channel of Dunardry Burn, where it must be formed by dams, as upon the other side of the summit.

48. I propose one lock near the head of the moss, and by extra cutting and banking, to carry the canal on such a level through the rest of it as to be able to lock down by a lock of 6 feet fall to the high-water of tides in Crinan. This lock to be so constructed as to admit vessels when a defective neap sets up only 2½ feet water.

49. The channel of Add must be deepened, and maintained so by the means mentioned for Gilp (40), and some repairs should be bestowed upon the harbour at the peninsula (15), there appearing to me to be no other works absolutely necessary for the safety of vessels drawing 6½ feet water.

50. The 7 feet depth of water here proposed being the same as that of the great canal of communication now making between Forth and Clyde, I would propose the breadth of bottom to be like it, of 24 feet, the locks to be also 20½ feet wide, 72 feet long, and 8 feet fall. As the other particulars relating to the construction of such a canal are sufficiently known to the public by Mr. Smeaton's Reports upon the subject, which I would propose to follow, insofar as they are applicable in this present situation. I shall not enlarge further upon it, except in settling the supplies of water.

51. The water of Gilp at present runs into Dunimuck Mill-dam, upon the very summit part of it; sometimes finds its way to Crinan, though its natural channel is towards Gilp. It comes from high mountains upon the south side of the valley, and seldom is so little as not to furnish water to Dunimuck Mill for at least six hours in the twenty-four. The two heads of Dunardry Burn, taken together,

APPENDIX C.

SUPPLEMENT.

TARBERT.

No. 481.
Watt, on a Canal at Crinan and at Tarbert.

are nearly of the same size with the head of Gilp, and can be easily turned into the channel of partition.

52. The weather being rainy when I was in that country, prevented me from making any accurate examination of the size of the burns; when I saw them, either Gilp or Dunardry Burn could have furnished as much water as would drive an ordinary corn-mill constantly, or for twenty-four hours in the day. A very minute inquiry into the lowest state of the waters did not appear to be necessary, as I was informed that both Gilp and the other burns take their rise from lochs in the mountains. This was confirmed to me by Mr. Morrison, my assistant, whom I sent to examine that matter, while I was employed in some other part of the business.

53. The two lakes from which the principal branch of Gilp proceeds, taken together, are about 600 yards long, and 200 yards wide, and the lake from which one branch of Dunardry Burn proceeds is about 1200 yards long and 200 yards wide. They are all of them capable of being pent up higher, at a small expense, and would then not only become deeper, but would also cover more ground. I shall only consider them as deeper, without regard to any other enlargement of their dimensions, which, however, will be considerable.

54. Suppose, then, that they were so much raised in their surface that they could be run off to six feet deep, they would afford a supply of 19,440,000 cube feet of water. A lock of the size proposed requires nearly 12,000 cube feet of water to work it. Every vessel passing this isthmus will consume two lockfulls, and I shall suppose the number of vessels to be passing daily to be twelve; this consumption will be twenty-four lockfulls: the leakage at the two locks of the canal of partition may be supposed four lockfulls daily; the evaporation of that district, which must be supplied from the canal of partition, supposed at one-tenth of an inch daily over the whole surface, amounts to 3,300 feet. This canal will be little liable to suffer by soakage, for excepting what it may lose at the dams proposed in the glens, on both sides of the summits, the soakage can be supplied from other sources, and it is probable that more will be furnished by springs in the deep cut at the summits than will be lost by this article. I shall, however, suppose it equal to the evaporation, or 3,300 feet daily.

55. Our account of water now stands as follows:—

	Cube Feet.
Twelve vessels consume 24 lockfulls, or	288,000
Leakage " 4 "	48,000
Soakage and evaporation	6,600
	342,600

By which it appears the reservoir proposed (54) would supply the navigation nearly fifty-seven days, independent of rains, or the ordinary run of the burns, and as rains are very frequent here, and also more violent than in the low country of Scotland, I imagine these reservoirs would be sufficient for securing the daily passage of the number of vessels mentioned; but if they should not, it will not be difficult to pen the water in the locks still higher, and to make reservoirs in other places, opportunities for which are frequent.

56. If a canal of ten feet depth of water was to be put in execution in this situation, the principal variations from the plan laid down for the seven feet canal would consist:—1st. In the surface of the canal of partition being three feet higher than in the other case, for on account of the reasons I have mentioned (46), it may not be proper to dig it deeper than the 16 feet of extra cutting and the seven feet canal formerly proposed, so that in order to have ten feet depth of water, the surface must be raised three feet.

2nd. The two tide locks must be increased in their fall three feet each, to make up the three feet additional height at the summit; these locks must also be made three feet lower in the bottom than in the other case, which, upon the Crinan side, will be attended with considerable difficulty, on account of the small rise of the tide; for the bottom of the locks should be ten feet under the surface of low neap tides, which I suppose only to set up three feet above the low water. I observed, consequently, it would be seven feet under that low water. It is very expensive to construct works in such circumstances, and it is also exceedingly troublesome to maintain them.

3rd. The channel through the sands of Gilp must be made deeper.

4th. The bar in the outer bay of Crinan must be removed by dredging, and a jetty extending about 400 yards from the end of the rocky peninsula, northward, must be built of such a height as to be above the ordinary spring tides, its use being to confine the ebb tide and the current of the water of Add, and thereby to prevent the formation of the bar.

5th. The channel of the water of Add must be deepened greatly through most of the inner bay of Crinan.

6th. Both from my own experience and that of other people, I think it is very problematical whether a canal of ten feet deep, with sufficient banks, can be carried through the bay on the east side of the summit (26) in the line proposed for one of seven feet deep, I would therefore propose to carry it close in by the foot of the hard ground, on the south-west side of the valley, which will lengthen it somewhat, and perhaps occasion a disposition of the locks a little different from that now proposed.

57. The sizes of the locks, and their rises or falls, being supposed the same for the ten feet as for the seven feet canal, the supplies of water required, except in the article of soakage and evaporation, will be exactly the same, and the difference occasioned by these two articles will be so trifling as not to merit much attention.

58. According to what has been said, I proceed to estimate the expense of the two canals, from a comparative view of which, and their advantages and disadvantages, the propriety of either of them in this situation may be judged of:—

Estimate of the Expense of making a Canal of Seven Feet Depth of Water, from Loch Gilp to Loch Crinan.

		£.	s.	d.
50.	To cutting the canals, the average depth being supposed to be 9 feet, the bottom 24 feet wide, with slopes, as 5 to 3, it will contain 39 cube yards in the running yard, and in a mile, 68,640 cube yards, which, at 5*d.*, amount to 1430*l.*, and for 4⅛ miles	5898	15	0
46.	To cutting in the canal of partition 1100 running yards, 24 feet deep at the summit, and diminishing as by the section 100,000 cube yards, at 8*d.* per cube yard	3333	6	8

		£.	s.	d.
44.	To extra cutting rock at Bad-dana Cranavan, and two other places near it	600	0	0
40.	To extra cutting a new channel for Gilp, from A to B, 400 running yards	300	0	0
	To cutting a new channel for ditto, through the sands to low-water mark	700	0	0
40.	To securing the sides of same with rubblestone, and raising two heads near low-water mark	1,600	0	0
41.	To cutting a new channel for the burn of Altnachulatright	50	0	0
32.	To extra cutting rock near Dunardry town	200	0	0
	To turning aside and making up the highway at the summit, and at the foot of Dunardry hill	100	0	0
49.	To deepening the channel of Add	200	0	0
	To securing its sides for a quarter of a mile	200	0	0
	To cutting a new channel for Dunardry Burn	50	0	0
	To passing places, and other extra digging, the value of a quarter of a mile of canal	357	10	0
	To towing-paths, back drains, &c., 5 miles, at 40*l.*	200	0	0
52.	To damming the locks, and making other reservoirs	400	0	0
50.	To 14 locks of 8 feet rise or fall, each 20 feet wide and 72 feet long, 1000*l.* each,	14,000	0	0
	To two draw-bridges at the summit, and at Loch Gilp bead, 400*l.* each	800	0	0
	To 20 in falls and over-falls for receiving and discharging water, as the grounds do not admit of tunnels to carry it under	200	0	0
49.	To building a pier at Crinan	100	0	0
	To one ditto at Loch Gilp	100	0	0
65.	To ground for the canal and banks, drains, &c., 54 yards wide, being $15\frac{6}{10}$ scots acres, per mile, and for 4¾ miles, 74 ocres, rated at 10*l.* per acre	740	0	0
	To ground for other purposes, 20 acres	200	0	0
		30,329	11	8
	To contingent and incidental expenses, 15 per cent.	4,549	8	8
	Total . . £.	34,879	0	4

Estimate of the Expense of making a Canal of Ten Feet Depth of Water, from Loch Gilp to Crinan.

		£.	s.	d.
	To cutting the canal 27 feet broad at bottom, or 12 feet deep slopes, as 5 to 3, containing in running yards 63 cube yards, and in a mile 110,880 cube yards, which, at 6*d.* per cube yard, amount to 2,772*l.*, and for 4½ miles to	10,434	10	0
56.	To cutting in the canal of partition to a 27 feet bottom, 106,325 yards, at 8*d.*	3,544	0	8
	To extra cutting at Bad-dana-Cranavan	600	0	0
	To cutting a new channel for Gilp	300	0	0
	To cutting ditto through the sands, supposed 3 feet under low water	1,400	0	0
	To securing the sides with stones	1,600	0	0
	To a new channel for Altnachulatright	50	0	0
	To cutting rock at Dunardry	200	0	0
	To altering the highway	100	0	0
	To deepening the channel of Add and dredging the bar	600	0	0
	To securing sides of new channel with stones, three-quarters of a mile	1,200	0	0
	To cutting a new channel for Dunardry Burn	50	0	0
	To passing places, the value of a quarter of a mile	693	0	0
	To towing-paths	200	0	0
	To making reservoirs	400	0	0
	To 14 locks of 8 feet fall or rise, 20 feet wide and 72 feet long, 1200*l.* each	16,800	0	0
	To extra building, drainage, &c., at each of the two tide-locks, which are supposed to be equal to locks of 10½ feet fall, and must be made with conveniences for occasionally keeping off the tide water in time of repairs, 400*l.* each	800	0	0
	To two draw-bridges	800	0	0
	To infalls and overfalls	200	0	0
	To two piers at Crinan and Gilp	200	0	0
	To a jetty to defend the entry of the inner lock at Crinan, and to keep deep water there, extending 400 yards, at 2*l.* per yard	800	0	0
	To ground for the canal and banks, 67 yards wide, $19\frac{4}{13}$ Scots acres per mile, for 4¾ miles, 92 acres, at 10*l.*	920	0	0
	To ground for other purposes	200	0	0
		42,091	10	8
	To contingencies, 15 per cent.	6,313	14	7
	Total	48,405	5	3

N.B. In the last article allowance is only made for the charge of an ordinary Act of Parliament, independent of any charges that may be brought on by litigation or otherwise previous to the execution, the remander being for accidents, surveyors' and clerks' salaries, and articles omitted in the estimate.

59. In the foregoing estimates, I have rated the cutting of the earth at higher prices than it could be executed for in the low country of Scotland. It will here be more difficult to procure proper workmen, and to provide them in provisions, lodgings, &c. The weather is more uncertain, and the men being thereby often thrown idle, must have higher prices for what they do, besides the greater risk of damage by excessive rains. The soil is also sometimes, in a short space, of many different qualities; and at the summit the boggy part is of the worst species of earth for standing upon; even with the most experienced artists some parts of it may fail, or, at least, must be secured by expensive works.

60. With regard to the locks, I have supposed them to be mostly built of the stone of the country, which is hereabouts a blueish whin (a species of schistus), rising generally in flat, well-shaped pieces.

It is rather too hard to be hewn, but works very well with the stone hammer. There also are some kinds of it somewhat like the Inverary stone, that works with the mason-irons; but all of them that I saw are more difficult to work than freestones are. But failing them, freestones can be procured from the island of Arran, by a water-carriage of 20 miles.

61. Many of the locks may be founded upon the rock, the saving thereby, in my opinion, will compensate for any extraordinary charge that will be occasioned by the hewing or carrying of the stones.

62. In regard to the works I propose to execute in the tideway, I must observe, they cannot be estimated with the same degree of precision as works upon the firm land; but that I have made such allowances as I judged necessary upon them, and think they may be executed near the prices I have affixed to them.

63. Although I propose to execute the canal in the narrow glens (45) by making dams across them, I have estimated the whole as if it were to be dug out of the soil. For although I imagine, from the plenty of materials that lie upon the spot, that these dams will be executed for less money than spaces of the canal equal to what they will lie under water are estimated at, yet their formation is subjected to more accidents than that of cutting a canal in solid ground, and it will be more difficult to find undertakers for works of that species.

64. In digging the new channels for the waters of Gilp and Add, I have supposed that much assistance will be received from the waters themselves, otherwise the estimated prices of these articles are too low if they were wholly to be performed by digging or dredging.

65. In regard to the price of land, I am entirely ignorant of it, and have affixed a price to that article merely to complete the estimate. I have fixed it low, because little of it is arable, and a great portion of it boggy. I also imagine that the advantages of such a canal to the landholders would of itself be more than a compensation for any damages it would do them.

66. To determine which of the two canals will be most proper in this situation requires the knowledge of several particulars, concerning which I have not been able to procure satisfactory information. These are, the size and number of vessels that may be reasonably expected to pass this way, and the destinations of those vessels, whether for the North Highlands and isles, or for foreign parts.

67. I shall, therefore, instead of pretending to judge in that matter myself, deliver such things only as I apprehend will assist those that are otherwise better informed in determining the point.

68. The canal of 7 feet water will answer the end of giving a safe passage to such small vessels as in bad weather dare not attempt to go round the Mull of Cantyre. Vessels may also be constructed to answer the end of herring busses, and yet be capable of passing here. But the present Herring Bounty Act would be an obstruction to that alteration; for vessels so made could not draw so much bounty in proportion to their real tonnage as those in present use. Seven feet being the depth of the Forth and Clyde navigation, the largest vessels that can pass there might also pass here.

69. The expense of this canal being supposed to be 36,000*l.*, and the expenses of the other to be 49,000*l.*, the difference is 13,000*l.*, and the interest of that difference at 7½ per cent., which, upon a sunk capital, where repairs are necessary, is lower than it ought to be placed, amounts to 978*l.* per annum.

70. My ignorance of naval affairs prevents me from being able to fix the rate per ton that could be afforded to be paid for the passage hire. I shall, when I have described the Tarbert passage, give my opinion of it; in the mean time I beg leave to call it 1*s.* 6*d.* per ton of the vessel's burthen, to be paid, loaded or not, for the expense of navigating a vessel, being in either case equal. The saving to the owner must also be equal, excepting upon the article of insurance.

71. To make the 10 foot canal an equally advantageous undertaking with the 7 foot, there must pass upon it 13,000 tons more than upon the other, which supposing the average size to be 30 tons each, amounts to 433 vessels annually. This canal being supposed to be of public utility, and to be undertaken without any view of receiving the full interest of the money, considered in the light mentioned (69), I shall place the interest only at 5 per cent., or 650*l.* annually. To pay that interest would require the passage of 8666, at 1*s.* 6*d.* each, or 288 vessels of 30 tons burthen.

72. The advantages of the 10 feet canal are evident—many of the present busses could pass it, besides the ordinary sloops and brigantines that trade to the isles, and some of those that go to foreign parts. Upon the whole there can be no doubt that the number of vessels passing upon the 10 feet canal would greatly surpass that of those passing upon the 7 feet canal; but whether it would exceed it in the necessary proportion is what I cannot take upon me to determine.

Description of Tarbert Passage.

73. The isthmus of Tarbert, as has been mentioned, is formed by the East and West Lochs Tarbert. I shall, according to the method I pursued in describing the Crinan passage, first give some idea of these lochs, and then of the passage itself.

74. The East Loch Tarbert is, like Gilp, a branch of Loch Fyne, and is situated upon its north shore, about six miles from the point of Skipness (9), and about 16 computed miles from the head of Loch Gilp. It is about three-quarters of a mile in length, but it is very irregular in its breadth; it is contracted near its middle, but opens again to a greater width. The inner part forms a most excellent harbour, having in general from 3 to 4 fathoms water at low water, upon a sandy bottom. Immediately within a low rocky point, which forms the contraction just mentioned, lies a small island also rocky; the best passage into the harbour lies upon the south side of this island, that upon the north being somewhat foul, and having rocks in it that are covered at half tide. Notwithstanding which this passage is used by those that are acquainted with it. The situation of this island in the very entrance of the harbour gives great shelter from in-blowing winds, but renders it somewhat difficult to enter with a westerly wind.

75. The shores of the loch, except at the head, where it ebbs a considerable way, are bold and rocky; on the south side the land is very high and steep; upon the north-west it is lower, but exceedingly rocky. On the north-east are several small rocky hills that separate it from Lock Fyne; at its head, or west end, lies the isthmus or passage to the West Loch, and upon its south-west shore stands the town of Tarbert, consisting of about 100 houses, tolerably well built, though mostly upon the ground-floor. The inhabitants are principally fishers and dealers in herrings, and have several busses engaged in these trades. Upon the whole, I think this loch one of the finest natural harbours I ever saw, but I am of opinion it might be much improved: for further particulars I refer to the plan which I have taken care to lay down exactly.

APPENDIX C.

SUPPLEMENT.

TARBERT.

No. 481.
Watt, on a Canal between East and West Tarbert.

76. West Loch Tarbert has its mouth in the sound that separates Islay and Jura from Cantyre and Knapdale. It is about ten miles long, and three-fourths of a mile in breadth. Its general direction is north-east and south-west, pointing upon the islands of Islay and Gigha; the distance of its mouth from the mouth of Crinan, by the sound of Jura, is about thirty miles.

77. A little within the mouth of the loch lies the island of Trail, which is surrounded with rocks and foul ground, and it is at low water quite dry to the north shore, but upon the south side there is clear channel, having five fathoms water for above a quarter of a mile in breadth, the bottom being sand. From Trail upwards, for some miles, the main channel of the loch is clear, and has about five fathoms water.

78. Before my coming here I had heard of many sunk rocks in the channel of the loch; I have laid down all those that are detached, and that are at any time dry, and, after the most diligent inquiry, have only heard of one that is detached and is never dry. It lies near a farm called Tyniturk, on the north side of the channel, and has nine feet water upon it at low water.

79 About three miles from its head the loch is contracted to half a mile wide, but still maintains its depth; a mile farther up lies the island of Gallaghan, which is pretty large, and contracts the channel to a quarter mile in breadth Along its south side there is at low water, in the best of the channel, only three fathoms, and betwixt its east end and a point of the south shore of the loch there is only nine feet water at low water.

80. From the point first mentioned to the head of the loch, its breadth is about a quarter of a mile, and from the mouth of Avennagillian or Barravaille water to the same place, which is about a mile, the bottom ebbs dry, excepting a narrow channel. This channel is, at low water, from nine to twelve feet deep, and appears to be kept open by a burn that enters at the head of the loch. In this upper part of the loch the bottom is a deep mud, through which even a person on foot cannot pass but with the greatest difficulty.

81. The sides of Loch Tarbert are indented with several bays, which are generally shallow, and many of them ebb dry, but as I was confined in time, and did not consider it as a matter of great importance, I have not made such examination as enabled me to mark how much each of them ebbs, and have contented myself with laying down the form of the low-water mark at the head of the loch, in every other place I have laid down only the high-water mark.

82. The land upon the south side of the loch is not exceedingly high; it is, in general, sloping, with a great deal of arable ground. Upon the north side the land is very rocky, and in many places covered with brushwood: but, upon the whole, is rather lower than that upon the south side. I mentioned the height of the land particularly, because it is alleged in narrow seas, among high lands, storms or sudden gales of wind are common, and dangerous for shipping. The hills on the sides of West Tarbert are not so high as those on the most part of the Firth of Clyde.

83. The shallow part of the loch to the east of Gallaghan has apparently been produced by the sand brought down by Avennagillian, which is a considerable water that has its rise in the mountains, and in time of rains tumbles down a very steep channel with great violence. It has, by its depositions, formed a large piece of level ground at its mouth, through which it lately cut itself a new channel.

84. The neap tides in East Tarbert rise and fall about six feet and a half, and the spring tides about ten feet and a half. In the West Tarbert, spring tides flow only four feet and a half, and extraordinary tides about six feet and a half. I had no opportunity of examining the ebb and flow of neap tides; but as was observed of the tides in Crinan, they are here extremely irregular, and not to be depended upon, either as to time or height; when the weather is moderate there is six hours difference in the times of the tides of the two lochs.

85. Between the heads of the two lochs I have just described lies the isthmus of Tarbert, which is scarcely one mile in length from the high-water mark of the one loch to that of the other. It is a narrow plain, bounded upon both sides by rocky mountains; those upon the north side are high, steep, and craggy—those upon the south side lower, and, in general, not so steep.

At the east end the ascent to this plain is sudden, and not far distant from high-water mark The whole of that rise is rock, but the plain itself is in general a boggy moss, so very wet and soft that it was with great difficulty we could pass through it. It is covered with water-grass and other aquatic plants. I sounded the depth of the moss in many places, from which soundings I have been enabled to lay down the surface of the rock in a section of isthmus sent with this. The plain rises gently towards the west, till near its middle, when its height is about 45 feet above neap-tides high water in the East Loch.

87. At the summit the breadth of the plain is about 150 feet, but as the adjoining rocks are low they would admit of some part of the excavated materials being laid upon them.

On the west side of the summit, the boggy part of this plain is narrow, and interrupted by jutting rocks, which, however, have in general a passage for a canal somewhat crooked. The ground among these rocks, after some space, ceases to be boggy, and is a kind of gravelly earth, but near to the North Loch the whole is rocky.

88. The rock of this isthmus consists mostly of one species of stone, which is hard, undulated, silvery grey schistus, or slate, with thin veins of quartz; this stone is subject to rot in the air. By examining specimens, lifted at the surface, one would imagine it was an easy matter to quarry it; but on entering into the rock, it is soon found of a more solid consistence, with few natural separations, remarkably strong and tough, difficult to split from the undulations of its fibres, which resemble knotty oak, and from the talky pieces intermixed in its structure, it is not easy to make a wedge stick in it. The only method of working it seems to be by gunpowder, which would have trifling effect upon it compared with what it has upon the whinstone of the low countries, which, though much harder than this schistus, is not so tough. To complete the difficulty, the direction of the canal appears to run the edgeway of the bed of the rocks. Nevertheless, there is reason to think that there will be found portions of it much easier to work than others, for some of these rocks are uniform in their quality, and I took care to examine the most solid parts I saw in the way, fearing that the greatest part might be of that quality.

89. To carry a canal in 7 feet water in this isthmus, a channel should be cut through the sand from low-water to the high-water mark of the East Loch.

The sides of this channel must be defended with stones as at Gilp, and its depth ought to be as low as that of low water of spring tides.

. By carrying the canal a little to the north of the tract of which the section is made, the first lock

APPENDIX C.

SUPPLEMENT.

TARBERT.

No. 481.
Watt, on a Canal between East and West Tarbert.

may be situated at the land end of this channel, where it may be dug out of the rock, as may also the three next ones. Ten feet of the height of the summit may be reduced, and the remaining height of 34 feet may be ascended with four locks.

The descent upon the west side may also be divided into four locks, which must have a greater fall than those upon the east, because the surface of the tides is about 2 feet lower upon the west side. By examining the ground with attention, I think it will be easy to find situations where these descending rocks may also be dug out of the solid rock or only founded upon it, as may be found more advantageous.

In the West Loch, a channel must be made somewhat more than a quarter of a mile in length, in order to reach the deep water.

90. For a 10 feet canal no other variations appear necessary, except those that are implied in the greater size of the canal.

91. The question of the greatest depth of water proper to be given to a canal across this isthmus cannot easily be solved without some knowledge of what expense could be afforded; if that is supposed to be moderate, the depth is evidently limited to 12 feet by the bank (83), and that reaches from Gallaghan Island to the south shore; for though the bank has in ordinary springs 13½ feet water upon it, yet it must often happen that in defective tides it will have less than 12.

92. It is very true that it does not appear impossible to deepen a channel through that bank artificially; but at what expense it can be made deep and maintained so is a point I cannot at present take upon me to determine with precision. I shall only observe that it would in that case be proper to turn the Avennagillian into the loch by another channel; for the depositions of that water have formed the bank in question, and although it would be difficult to execute it, there appears to me a possibility of turning this water into the bay on the north shore just below Gallaghan. This bay is deep, remote from the channel of the loch, and would contain the depositions of the water for a very long time.

93. Although I have mentioned 12 feet as the depth of a canal that might be obtained, I shall confine my calculation of expense to a 7 and 10 feet canal, conceiving that any increase of the depth beyond the latter would not be materially more useful unless it could be extended to 16 or 17 feet, which would admit the American traders.

94. I have also calculated the expense of a thorough cut of two dimensions of 40 feet wide, 16 feet water, and 33 feet wide, and 12 feet water.

95. It must be considered, with respect to the expense of such a cut—1st, That the depth of 16 feet is 10 feet deep under the low-water of neap tides in the Firth of Clyde, and 8 feet under that of spring tides. This circumstance will probably occasion an extensive drainage both from the natural waters of the rock itself, and from the sea-waters as it approaches to the Ends. In the cut which has only 12 feet water that drainage will be much less, both on account of the lesser depth and of the shorter time it will be continued.

96. Secondly, the whole mossy earth must be entirely removed for many yards upon both sides of the cut, because its soft quality will not admit of its being loaded with the stones taken out of the rock.

97. Thirdly, it will be found difficult in such confined situations as occur in many parts of this isthmus to find room to stow the materials proceeding from so great an excavation. Part of the stones must be built into regular walls to support the rest, and a considerable part must be entirely carried off the field; with these I would propose to form the sides of the channels or entries to the cut from the East and West Lochs. The expense of these last articles will be proportionably much greater in the deeper cut, from the greater quantity of materials to be removed.

98. I own myself greatly at a loss to fix the price at which this rock may be wrought per cubic yard; nor do I think that any man who has not executed some work on the same kind of stone can be a judge of it, neither are superficial prices, such as quarrying for common purposes in the looser or upper parts of the rock, any proof of the expense of working it in the bowels of the earth in a confined situation. Nevertheless, that the estimates may be as complete as possible, I have supposed the earthy part to be paid for only of the same wideness with the rock, and have comprehended the whole at the price of 5*s.* each cube yard in the 16 feet cut, and 4*s.* each cube yard in the 12 feet cut, and have supposed these prices to comprehend drainage and the furnishing of machines and utensils of all kinds.

99. As the high-water surface in the Firth of Clyde is higher than that of West Tarbert, I have supposed the depths to be regulated by the former.

100. For the reason just mentioned, and because the high water of the one loch often coincides with the low water of the other, it will be necessary to fix flood-gates at both ends of the cut to retain the water in it always nearly one height, to prevent the waters of the Firth from running through with violence to the ocean, and to serve by way of locks in lifting vessels from the level of the lochs into the cut. For these purposes at least three pairs of gates at each end will be necessary—one pair to shut out the tide and to defend the inner gates, and two pairs serving by way of a lock.

101. It has been a common notion that a great point to be gained by cutting this rock will be the acquiring more height of tide in the Firth of Clyde. What has been said of the heights and the times of the tides in the two lochs may of itself serve for a sufficient confutation of this opinion; but even allowing these circumstances to be as favourable as could be wished, can it be supposed that any quantity of additional tide that can pass through even the whole channel of Loch Tarbert, supposed half a mile wide and 5 fathoms deep, can bear a sensible proportion to that which enters by the mouth of the Firth, which is at least 20 miles wide and 40 or 50 fathoms deep?

102. One of the greatest difficulties that has appeared to most people who have considered this isthmus as a tract for a locked canal, appeared to be the finding of a sufficient supply of water for the locks, and have found it no easy matter, not so much from a want of streams of water in the neighbouring hills as from the horrible ruggedness of their surface, which renders it extremely difficult to lead water-courses from any considerable distance.

103. The waters that rise in the hills upon the south side of the isthmus are those that can be most easily led to it, as no considerable valleys intervene, but unluckily there are no large streams among these hills, and not many places where reservoirs can be easily formed. After much search, I found one place where about 5 acres of ground could be covered with water to the depth of 9 feet upon the average, and having a considerable quantity of low ground about it, would probably be filled in a few days of rainy weather. I saw also 4 other small streams that could be led to the summit, but all of them with difficulty, and at a great expense.

APPENDIX C.

SUPPLEMENT.

TARBERT.

No. 481.
Watt, on a Canal between East and West Tarbert.

104. From the examination I made, it appears to me that although there might be a possibility, by constructing reservoirs and making several water-courses, to collect as much water among these hills as might supply a tolerable navigation, yet that it would be attended with great expense, and not so certain as could be wished in an undertaking of so much consequence, I therefore turned my search towards the north side, where I found a considerable brook that drives a mill, and takes its source from a loch in the hills. But unluckily the valley in which this burn runs is at the west end, and greatly lower than the summit of our canal, and though, in going eastward, the valley soon rises to a sufficient height to admit of our leading off the water to the summit, yet that is rendered exceedingly difficult by a hill which stands between the two valleys, of which the north side is almost perpendicular, and reaches to the west loch. At any rate, this burn, though vastly better than anything upon the south side, will be far short of supplying such a navigation.

105. I therefore proceeded to examine whether or not part of the Avennagillian could be led this way, which I found practicable, though not easily, for it must pass along the side of uneven hills to the valley just mentioned; it may either join it so far as to cross to it upon the level of its bottom, or it may be carried over it in a wooden trough to the side of the steep hill, which it may pass through by a mine, or may, by making a circuit, cross it near the west end, in an open cast, as shall be found most eligible.

106. Avennagillian is a large water, and in the state in which I saw it, which I was told was a middling one, was more than sufficient to supply such a navigation as I have mentioned in the case of Crinan (54). It takes its rise from two lochs in the forest of Sligh-gavite. one of which. Loch Heiron-moir, is said to be about half a mile diameter, and capable of being pent up to a great depth. I saw more than one place upon this water where reservoirs could be made if necessary; I therefore think that this river alone gives ample security for the navigation being properly supplied with water.

107. I have mentioned (89) that most, if not all, the locks may be cut into the rock, where the rock is solid, and can be wrought tolerably smooth; this will occasion a considerable saving of expense, possibly even to half the price of each lock that can be so made, particularly as no freestone, or stone capable of being dressed by masons' irons, is to be found about this place, but must be brought from Arran or Cumra, and now, although they cannot easily be entirely formed in the rock, their having such a foundation is of the greatest consequence; however, as I cannot positively assert how far it may be practicable to follow these plans, nor how much may be thereby saved, I have estimated the locks at the same price as at Crinan, where only some of them can be so constructed, but where better building-stones can be easily had.

108. It appears to me at present that the best manner of conveying the canal through the bay and part of the isthmus, upon the east side of the extra cutting, will be by partly banking it above soil, or making it of a great breadth, to serve as a reservoir to contain a ready supply of water, and so prevent the canal of partition from being sensibly lowered by the entry of many vessels, which must always happen near the point of high water, as they can only at that time enter the canal, and also because I fear that at that end it is too soft to permit the canal to be dug deep into the soil.

109. In the West Loch the channel leading to the deep water ought to be made as near the hard ground as the rocks will permit, and it will then only require to be secured from the sea upon one side. A small jetty head will be necessary here to assist vessels in turning into the cut, the mouth of which will not be in the direct line of the channel of the loch, which is of itself narrow.

110. It may be observed that in both East and West Tarberts the entrances of the canal are more sheltered than the one in Gilp, and that not being intended for the channels of great waters, as is the case at both Crinan and Gilp, they do not require to be so strongly fortified with stone.

Estimate of the Expense of making a Canal of Seven Feet Depth of Water over the Isthmus of Tarbert.

	£.	s.	d.
To cutting a channel through the sands at the east lock, 160 yards long, and as deep as spring-tides low water, containing 4,080 cube yards, at 8*d*., part of it being supposed rock and part to be done by dredging	136	0	0
To covering the banks with stones, and building two rubblework heads at the end of the channel	148	10	0
To cutting the canal in rock, 176 running yards, 8 yards wide, and on the average 3 yards deep, the parts occupied by four locks being included in that length, serve as an allowance for making the canal a greater breadth between them, 4224 cube yards, at 5*d*.	1,056	0	0
To the cutting and banking of the canal through the bog to the east of the extra cutting, 415 running yards, made 100 feet wide at bottom, with slopes, as 2 to 1, containing 25,398 cube yards, at 4*d*.	423	6	0
To cutting at the summit, 17 feet deep, being 10 feet extra, and rising from 7 feet deep at each end, 553 running yards, containing 37,013 cubic yards, which, enclosing the rocky part, the quantity of which is not absolutely certain, at 1*s*.	1,850	13	0
To cutting to the west of the extra cut, 460 running yards, supposed to be partly cut and partly banked upon the rock, earth being to be had for that purpose, 19,320 cube yards, at 5*d*.	402	10	0
To cutting mostly in rock, 110 running yards, containing 1760 cube yards, at 5*s*.	440	0	0
To cutting a channel along in the West Loch to deep water, about 600 running yards, containing 18,000 cube yards, at 8*d*.	600	0	0
To securing the outside and top of that bank with stones	125	5	0
To a jetty head at the west entrance, with conveniences for making fast vessels, &c.	50	0	0
To eight locks of 9 feet rise or fall	8,000	0	0
To extra works at the sea locks	200	0	0
To one drawbridge	400	0	0
To back-drains and towing-paths	50	0	0
To bringing the Avennagillian to the summit	1,500	0	0
To ground for canal and banks, water-courses, extra cuts, wharfs, &c., 90 yards wide, one mile long, 26 acres nearly, at 10*l*.	260	0	0
	15,642	4	0
To contingent expenses, 15 per cent.	2,346	6	6
	17,988	10	6

Appendix C.
Supplement
Tarbert
No. 481.
Watt. on a Canal between East and West Tarbert.

	£.	s.	d.
The estimate of a seven foot canal is	17,988	10	6
To additional charge upon eight locks, 200*l.* each	1,600	0	0
To additional extra expense of the two sea locks, on account of the depth, 100*l.* each	200	0	0
To deepening the channel in the East Loch, 1,360 cubic yards, at 1*s.*	68	0	0
To deepening the basin east of the summit cut, 13,695 cubic yards, at 5*d.* per cube yard	285	6	3
To deepening the rock, 176 running yards, 1,408 cube yards, at 5*d.*	352	0	0
To deepening the summit cut in rock, in the running yard, number of cubic yards in all, 5,550, at 5*s.*	1,387	10	0
To deepening or banking higher the cut west of the summit, 9,200 cube yards, at 6*d.*	230	0	0
To deepening the rock at the west end, 880 cube yards, at 5*s.*	220	0	0
To deepening and widening the channel in the West Loch, 13,680 cube yards, at 1*s.*	684	0	0
To securing ditto in a stronger manner	100	0	0
	23,115	6	9
To contingencies, 15 per cent.	769	0	3
	23,884	7	0

Estimate of making a Thorough Cut at Tarbert, Sixteen Feet Deep at Neap-tides High-water.

	£.	s.	d.
To cutting from the deep water in East Tarbert to the deep water in West Tarbert, 36 feet wide at bottom and 40 feet at the water's edge. 388,004 cube yards, at 5*s.*	97,001	0	0
To cutting a channel 1,200 yards long, 100 yards wide, and 4 feet deep, through the bank betwixt Gallaghan and the south shore, and carrying off the materials, 160,000 cube yards, at 8*d.*	5,333	6	8
To six pairs of flood-gates, 33 feet wide, with fixtures, 400*l.* per pair	2,400	0	0
To ground for the cut, &c., 30 acres	300	0	0
	105,034	6	8
To contingencies, &c., at 15 per cent.	15,755	2	9
	120,789	9	5

Estimate of making a Thorough Cut at Tarbert, of Twelve Feet Water.

	£.	s.	d.
To cutting from the deep water in the loch to the deep water in the West Loch, 30 feet wide at bottom, 33 feet wide at the water's edge, containing 297,819 cube yards, at 4*s.* per yard	59,563	12	0
To cutting the bank at Gallaghan 2 feet deep, 100 yards wide, 12,000 long, 79,200 cube yards, at 8*d.* per cube yard	2,640	0	0
To ground, 30 acres	300	0	0
To six pairs of gates, 28 feet wide, 300*l.* per pair	1,800	0	0
	64,303	12	0
To contingencies, &c., 15 per cent.	9,545	10	9
	£73,849	2	9

Description of the Harbours between the Passages.

111. Having now described and settled the expense of canals at 10 feet and 7 feet deep at both Crinan and Tarbert passages, I proceed to give some account of the harbours that lie between them in the Sound of Jura.

112. The Sound of Jura is formed upon the west side by the island of Jura, said to be about twenty-four miles in length. It lies in a north and south direction, and is in general high land, and at the south end there are two hills, called the Paps of Jura, that are remarkably high. The eastern shore of this island appears to be very bold or steep, with few detached rocks. It has also a few harbours; I only heard of three. First, a bay near its north end, where small vessels may ride with a westerly wind; secondly, the small Isles Harbour near the middle of the island, which is esteemed a good harbour for vessels of any size; thirdly, vessels can ride safely in some part of the sound that separates Isla from Jura.

113. The coast of Knapdale forms the east shore of the sound of Jura, and extends from the mouth of Loch Crinan to the mouth of the West Loch Tarbert. It is a very rugged, rocky coast, and contains several good harbours. The more northerly is Barneshallock, said to be a very safe small loch, with an island in its mouth. The second is Loch Nakeill, which I was in. There is good riding in six fathoms water on a clean sandy bottom. The breadth of this loch is about half a mile, and the length of the deep water about three-fourths of a mile; it is well sheltered from the north-east and south winds, but is open to the south-west. Thirdly, Loch-na-chastel, or Loch-castle-sweyn (so called from an old Danish castle), is said to be a safe harbour, but is not so much frequented by ships as Loch-no-Keil, from which it is only one mile distant; this loch appears to be one mile wide, and is several miles long. I was assured by several persons who know it, that it has a clean bottom in general. From its situation it is sheltered from the same winds as Loch-no-Keill. Fourthly, in the sound opposite to the mouth of the last loch, and about two miles distant from the shore, lies Eilen-moir-mach-cobarmig, or Isle MacCormack, which, though it is only a small island, has a good harbour upon its north-east side. This harbour is of a semi-circular form, and is well sheltered from the south by small hills upon the island, and it is said it is tolerably safe riding there even with a northerly wind. Fifthly, Loch Kullisteté, commonly called Kullisport, is situated farther south than Loch-na-chastel, and upon the same coast. It is also nearly of the same size. It has a sufficient depth of water for any vessels, but has been said to have a foul bottom. I made inquiry concerning this point, and was assured by a gentleman residing in the neighbourhood, who has often examined it, that it has a very clean bottom, and it is a very safe harbour, but has never been much frequented by shipping. From the mouth of Loch Kullisteté to Loch Tarbert there is no considerable harbour.

APPENDIX C.

SUPPLEMENT.

TARBERT.

No. 481.
Watt, on a Canal between East and West Tarbert.

114. South west of the mouth of Tarbert lies the Island of Gigha, where there is one or two harbours, which some people say are not very safe ones.

115. The setting of the tides in the Sound of Jura was an object recommended to my examination; I had little opportunity or time to make those examinations, but found what follows to be the general state of the case. Part of the great body of water that comes in between the north end of Ireland and the Island of Islay runs north into the Sound of Jura, where it rushes along with great velocity, and I am told that within the islands it continues to set in the same direction as far as the Sound of Mull. The tide of ebb, upon the contrary, sets with equal impetuosity from north to south.

116. In the Sound of Islay, which separates that sound from Jura, the tide of flood runs with exceeding great violence from the Sound of Jura to the ocean, as the ebb tide sets from the ocean towards the Sound, and it is not safe for ships to pass through it when it is in its greatest fury, for it has been known sometimes to drag vessels from their anchors.

117. The Gulf of Corivrechen, which separates the north end of Jura from the sound of Scarba, exhibits a striking phenomenon. The tides, which set violently through the Sound of Isla, rush through this gulf with the greatest fury, and if opposed by the wind, produce a set of waves raging beyond the bounds of credibility. Were it not a notorious fact, I should be afraid to tell, that from the bottom of the outer bay of Crinan, at a distance of 12 miles, I saw with my naked eye the white waves breaking against the end of Scarba.

118. At first sight it appears odd that a tide of flood should set from an inland sound to the ocean, but the cause will be obvious if it is considered that the high waters in the ocean are not everywhere at the same time, and from the fact I have just related, it appears that the high water of the ocean happens at the north end of Jura sooner than in the mouth of the North Channel, consequently it may be about low water in the Atlantic in the outer end at the same time that it is high water at the inner end of Corivrechen, in the Sound of Jura; to this may be added, that the tides in the ocean rise and fall but a small height comparatively to what they do in sounds among lands, so that the high water in the sound may be higher than that of the ocean.

119. I have not been able to get a positive answer to the query, whether vessels coming from the North Highlands do commonly pass through the Sound of Islay or between Scarba and the mainland, that is to say, by the Sound of Jura. I shall, therefore, hazard my own opinion upon this subject, which is, that middling vessels coming from the Lewis, or more distant places, will, with certain winds and good weather, run directly for the Sound of Islay or the North Channel; but that those vessels in other winds, and small vessels at all times, will choose to come by the inner sounds, because they can get into a harbour every night if they choose it, because the water is smoother, being sheltered by the islands, and because the tides I have mentioned will bring them along at a great rate, even when the wind is somewhat against them.

TABLE of Savings of Time and Miles by the two Passages.

	Hours.	Miles.	Hours.	Miles.
From Greenock to Crinan, by the Mull	..	..	84	127
From ,, ,, Tarbert	48	72	..	..
Time lost in Tarbert passage	6	..	..	..
			54	72
Saving by Tarbert passage . .	..	..	30	55
From Greenock to Crinan, by the Mull	..	..	84	127
,, ,, ,, Crinan passage . .	32½	52	..	..
Time lost in Crinan passage	9½	..	..	..
			42	52
Saving by Crinan passage . .	..	..	42	75

The advantages of the Crinan passage are—

1st. Being a more direct and shorter passage to the North Highlands and Isles.

2ndly. Being both more safe and more certain than the Tarbert one, from its entering Loch Fyne sooner, and from its being accessible with the winds blowing from more points of the compass.

3rdly. The having abundance of water naturally at the very summit.

Its disadvantages are—

1st. The great length of the artificial navigation and the number of locks.

2ndly. That the harbours of both ends are rather more exposed than could be wished.

3rdly. That the deep cut at the summit must be made in a very uncertain and mixed soil.

4thly. That several of the locks must be founded in boggy and other bad foundations.

5thly. That for a considerable distance it must be the common drain of a hilly country, and will require many precautions to prevent its being hurt thereby.

The advantages of Tarbert are—

1st. That it may be a passage not only to the north, but also to the islands of Islay and Jura, with the external coast of Knapdale, the west side of Kantire.

2ndly. The having very safe natural harbours at both ends.

3rdly. The shortness of the artificial navigation.

4thly. The possibility of cutting most if not all of the locks out of the rock, and the probability of thereby making them at a much smaller expense. The sea-locks in particular may thus be much more easily constructed to a great fall than where the artist is perplexed with mud, sand, or similar materials.

5thly. That there is no deep cutting in very soft materials, unless at the summit, where they may be entirely removed.

6thly. That a great part of the canal being rock, it will require few repairs.

Its disadvantages are—

1st. That it has not a direct passage to the North Highlands, and that the direction of the West Loch being towards the south-west vessels may be detained in it when the wind is otherwise fair for them. For the same cause with other winds, vessels may not have it in their power to enter the West Loch, and

APPENDIX C.

SUPPLEMENT.

TARBERT.

No. 481.
Watt, on a Canal between East and West Tarbert.

may be obliged to go into some other harbour, when with the same wind they could easily have made their passage at Crinan.

2ndly. That the West Loch is a long narrow passage in which vessels cannot conveniently tack, and that it is generally shallow near the shores and in its bays.

3rdly. The want of a sufficient quantity of water at the summit, and the being obliged to bring it from a considerable distance through rough grounds.

4thly. The great quantity of cutting in rock, the expense of which is rather uncertain.

People conversant in subjects of this kind are already sufficiently apprized that on a first survey it is not pretended to point out the very best method of executing a work, or to give an exact account of the price at which it may be done. It is sufficient that it proves the possibility and gives an idea of the probable expense, and consequently the propriety of making further inquiries. In this light I beg the public to look upon what I have said only as my present opinion of the methods of executing the canals, and of the expense at which they may be executed, assuring them that those opinions are the consequences of a deliberate and impartial consideration of the subject.

JAMES WATT.

A TABLE, containing some of the most material Facts concerning both Passages.

—	Time of Passage.	Computed Savings.		Length of Canal.		Number of Locks.	Perpendicular Height.		Expense.		
		Time.	Distance.	Within Locks.	On the Sea.		Natural.	Reduced.			
		Hours.	Miles.	Miles.	Yards.		Feet.	Feet.	£.	s.	d.
Seven feet Canal :—											
At Crinan . .	13	2	75	4¾	2000	14	70	54	34,879	0	4
At Tarbert . .	6	3	55	1	764	8	45	35	17,988	10	6
Ten feet Canal :—											
At Crinan . .	13	42	75	4¾	2800	14	70	57	48,405	5	3
At Tarbert . .	6	30	55	1	764	8	45	35	23,884	7	0

No. 482.

Report by Captain Sir EDWARD BELCHER, R. N., C.B., *on the proposed Argyll Canal, uniting East and West Lochs Tarbert.*

No. 482.
Belcher, on the proposed Argyll Canal.

SIR, *London, April 27, 1847.*

IN compliance with the instructions which I had the honour to receive from my Lords Commissioners of the Admiralty, under date of the 1st of April, 1847, and directing me to "examine into the propriety of connecting East and West Lochs Tarbert by such a canal as may facilitate the navigation of the adjacent waters, &c."

I have the honour to acquaint you, for the information of their Lordships, that I proceeded immediately to Glasgow, where I had, in the spirit of my instructions, invited Mr. Campbell, of Islay, to communicate with me, by letter, and inform me where he could conveniently grant me an interview.

Not receiving a reply at Glasgow, I moved on to Tarbert, where I met Mr. Campbell, just landed from the Islay steamer.

As this vessel crosses (at present) but once a-week (Wednesday), he had rightly calculated on meeting me before his reply could reach Glasgow.

As Mr. Campbell had already been apprized by Government of the purport of my mission, he had taken the precaution of chartering the "Islay" steamer (at his own cost) in order to facilitate the examination of West Loch Tarbert and the adjacent sound of Jura. He further introduced me to Mr. Campbell, of Stonefield, the proprietor of the greater part of the property through which the projected canal would pass, and who very kindly proffered the use of his maps and plans, as well as aid, in following out my examination of either of the lochs Tarbert.

It had been arranged by Mr. Campbell, of Islay, that our examination of the Western Loch Tarbert should commence on the following morning, and I was very anxious to have made the examination in its then disturbed state, but the violence of the gale, the heaviest known during the last ten years, rendered this impracticable.

On the evening of Friday the gale subsided, and early on Saturday morning we proceeded down the West Loch, aided by the best-informed pilots, sounding as well as probing the bottom with an iron bar, previously prepared, in order to ascertain to what depth below that indicated by the lead the dredging-machine would cut without being obstructed by rock or gravel.

This latter operation, I was informed, had been very rigidly conducted by the working engineer previous to the calculation of the estimates.

I see no difficulty in cutting a channel as deep as 24 feet at low water, from the proposed main cuttings at low water (which suddenly affords 12 feet), to the present depth, by lead, of 24 feet, and to be executed simply by the steam-dredge.

A small ledge of rocks occurs on the south limit of the cut, which may be avoided or easily removed. It does not vitiate the navigation.

From the depth of 24 feet to the mouth of the Western Loch, no obstruction to navigation by steam offers. If it be necessary to beat or sail down this narrow loch, a rock, having only two feet over it, may be avoided by a beacon or by its removal: it lies a little to the right of the direct course down the loch.

At the mouth of the loch is situated the island of Trien, which, at low water, is connected, by a reef, with the land at Ardpatrick, forming the well-sheltered harbour of that name, and in its present state offering a complete harbour of refuge to the western trade, or vessels of any size navigating the sound of Jura.

The anchorage, which ranges from 4 to 12 fathoms, is of mud and sand, and has tough clay beneath. It is completely land-locked. By filling up the interstices between the rocks, and placing

APPENDIX C.

SUPPLEMENT.

TARBERT.

No. 482.
Belcher, on the proposed Argyll Canal.

a beacon on the extreme edge, this harbour would be materially increased in its accommodation, and afford shelter to vessels of the largest class.

Lighthouses on the south extreme of the island, as well as on the northern point of the island of Gigha, would enable vessels seeking refuge to obtain it in the worst weather. Upon questioning our pilot, I was assured, "That no vessel seeking shelter, in the heaviest gales, had been known to fail in bringing up with decent ground-tackle, and that no heavy sea tumbles on it."

I am indebted to Lieutenant Bedford, R.N., for his remarks upon these lochs, and upon this point I find he states:—

"The ferryman at Ardpatrick, a resident of more than 30 years, bears testimony to the security of the shelter within the island, under all circumstances, never having known a vessel, with proper ground-tackle, to drive."

He also mentioned two instances within the last two years, of the Blind Channel (at high water between the island) being taken by strangers, running up in a gale of wind, suffering, however, no more than the partial loss of cargo and long detention on the ground.

Taken in conjunction with the proposed canal, this position becomes one of the greatest importance, and, aided by a lighthouse on the southern limit of Trien Island, would enable vessels not only to find shelter during southerly gales, but would also enable those bound to Glasgow to reach their destination by many days earlier, and without encountering the dangers, and wear and tear, experienced off the Mull of Cantyre.

From the opinions of many nautical men, acquainted with the Clyde navigation, the prevalent opinion was,—That if vessels could secure an offing within a reasonable period after the cessation of a westerly gale, that the Argyll Canal would be of the utmost importance; as vessels which now experience great difficulty in reaching Lamlash would easily and quickly reach Tarbert, and, passing through the canal, gain White Farlane Bay, in Islay Sound, from whence they would immediately reach the open sea by the first favourable slant of the wind; whereas they now idle away their time at Lamlash, and are cautious of venturing to round the Mull of Cantyre until a sufficient period has elapsed to permit the swell to subside; and this frequently causes a detention until another westerly gale has set in.

The same remark was made to me by a Liverpool merchant, adding—"We never can get our fellows out of Lamlash."

Referring again to the notes of Lieut. Bedford, he observes,—"From the testimony of the masters of the schooners Mary M'Gowan, Mary Stewart, and several others, vessels have been detained more than four weeks during the winter season in the ports of Lamlash and Camhelltown, unable from wind and sea to proceed round the Mull." A second, from the collector of the customs at Campbelltown, states, "That 44 vessels were detained in that harbour in the year 1845, bound round the Mull of Cantyre, principally to the West Highlands, a few to Crinan, and the rest farther north, all of which, had the dues been moderate and navigation easy, would have taken the canal proposed."

In the present condition of the western navigation between Islay island, and the Mull of Cantyre, it appears to be almost an established rule that masters of vessels, and particularly foreigners, decline to round the Mull of Cantyre, unless they can ensure "a flowing sheet," and never attempt to beat against a strong breeze.

That in these cases they either lie to under the lee of Islay, or seek sheter in some of its bays which, although safe, if properly surveyed, lighted, and beaconed, are not free from danger; it is owing to a want of proper knowledge of a position of these dangers that these places have acquired the reputation of "unsafe, dangerous, and treacherous."

One of the positions, Port Ellen, now undergoing improvement under the direction of Mr. Campbell, of Islay, offers shelter for vessels of war, and, if his intentions are carried out, will form a very complete refuge for a limited number of vessels. I enclose his outline plan, and will venture to say that any seaman with that document, even in its unfinished state, would not hesitate in seeking the shelter which nature now affords.

In illustration of the detention which results from these causes, applying to easterly as well as westerly progress, Mr. Campbell has informed me, "That no less than 127 vessels have been detained at one time about the ports of Islay, viz.:—

In Lochindaal	73
In Port Elleo	36
In White Farlane Bay (Islay Sound)	18
Total.	127

That these detentions extend to several weeks, and incur expenses varying from 17*s.* to 70*s.* per diem; and as the same breezes which caused the homeward-bound to seek shelter would have carried them safely into West Loch Tarbert, they would have reached the Clyde by the proposed canal, in smooth water, without any delay. It appears that vessels are in the habit of selecting the Sound of Islay in preference to rounding its southern end, and as many as "twenty square-rigged vessels" have passed through it in one day, all these would prefer the route by the Tarbert.

The completion of a ship-canal between East and West Lochs Tarbert would offer most important advantages to the vessels employed in the herring fishery in Loch Fyne, as well as to the westward of Tarbert. During the fishing season as many as 700 vessels have entered East Tarbert, at one time their crews amounting to more than 2,000 men and youths. It will be important that provision should be made, not only for their accommodation, but also to prevent their obstructing the line of navigation. This may be effected by confining the entrance on the northern side by a wall extending to Cock Island, and allotting the space enclosed north of that line to them. I am informed that the men engaged in these fisheries are not generally fishermen by calling, but in the herring season desert their farms to follow this temporary but lucrative occupation, realizing in many instances as much as 140*l.*, and generally about 40*l.* per man, the value of boat, nets, &c., averaging about 60*l.* That, instead of investing these proceeds for the improvement of their farms, or meeting their difficulties in times of need, that it is dissipated in drunkenness and other excesses. It is therefore to be hoped that the facility which this canal would afford to the pursuit of the white-fish trade would induce a more determined adhesion to the *bonâ fide* calling of a fisherman, and tend not only to furnish permanent occupation and subsistence to a large portion of the surplus population, but add materially to this valueable class of men, many of whom would doubtless become qualified to undertake the pilotage duties to foreigners seeking this channel.

Appendix C.

Supplement.

Tarbert.

No. 482.
Belcher, on the proposed Argyll Canal.

The banks, in the neighbourhood of the Island of Gigha abound in cod and other deep-water fish, termed the "white fishery." I am informed that it is usual for one boat to take between 60 and 100 stone of fish per day, which realizes, at Tarbert, 1*s*. 4*d*. per stone, and at Greenock, 1*s*. 6*d*., thus affording a fair prospect of 5*l*. per diem Upon the opening, therefore, of this channel, and the certain transit of steamers daily, direct to Greenock, a sure trade will be established at the highest price, and it is probable that a town will soon arise at Ardpatrick. This will be of the greatest importance to the fishermen of Gigha, who will not only find shelter, when driven from this ground in westerly gales, but, by affording them the facility of an immediate market for their fish, enable them to realize a much greater profit than by taking it to their homes, where it would be lessened about nine-tenths in value.

The cod is, however, salted and dried; and upon quitting Tarbert I witnessed one embarkation of ten cart-loads of very superior quality, which had been brought up West Tarbert by the boats, and carted over the isthmus, to be conveyed by the steamer to Glasgow.

All these advantages would be materially increased by the opening of this canal, and there is but little doubt that agents for the purchase and immediate transmission of fresh fish would be found at Ardpatrick.

The only objection which I have heard started against this channel is, "That westerly gales would throw in such a heavy swell that it would be impossible for vessels, *even after the gale had subsided*, to gain an offing;" and that "powerful steam-tugs would be indispensable."

To this I am able to give the most distinct denial, as upon reaching the mouth of Loch Tarbert and entering Jura Sound, I found, very much to my surprise, that after such a heavy gale of *three days' duration*, that the sea was as smooth as the Thames above the Nore.

The only positive objections which can be urged against vessels gaining an offing under canvass, or without the assistance of steam, are, a gale, or calm, and these apply to every port; but with any weather which would enable a vessel to navigate in the open sea free from this Loch, I consider that she would quit this port with great facility, be encouraged by immediate shelter under Gigha Island, and upon emergency enabled to return without a danger in her course to a secure anchorage at Ardpatrick, an advantage which does not present itself in any other port of this coast.

Upon the other hand, under precisely similar difficulties, we may inquire what would result if the attempt were made to beat round the Mull of Cantyre, where the meeting of the winds and currents, after even *strong westerly* winds, sets all ordinary navigation at defiance?

At the moment that the vessel in Jura Sound was making good work to windward, and had, probably, assisted by the tide, gained Whitefarlane Bay, the other by pitching and rolling off the Mull, would scarce gain "steerage way," and upon any sudden westerly breeze would seek safety in the port she had quitted.

These are points connected with the advantages to be derived by our mercantile marine; but in a military point of view this channel affords most important advantages to the naval defence of the western ports of Scotland.

In the event of war, some naval rendezvous, as well as coal depôt, must be formed in the neighbourhood of the Clyde.

The enemy would doubtless have cruisers watching the Glasgow as well as Irish trade; and we know that the Americans, in the late war, made rather free upon Islay.

We will suppose the enemy's cruisers caught by a westerly gale between Ireland and the Mull of Cantyre, and that the fact of his being there is conveyed to our cruizers in the Clyde,—before any of our steamers could reach or pass the Mull of Cantyre, even if she could face the gale as well as the sea, she might, by adopting the Tarbert channel, pass with ease in smooth water to the southern point of Islay in a *state of efficiency*, seek the enemy to leeward, and prevent escape; or, should her services be required on the northern coast of Ireland, her arrival by this route would be certain, when it might be impolitic, if not impossible, to attempt it from the Clyde direct.

This West Tarbert Loch furnishes the only distinct "Port of refuge" which can be safely sought *to leeward* in these northern seas. It is free from every danger to the anchorage of Ardpatrick, to which a vessel may be guided by lighthouses on Gigha and Trien Islands. If she should be in a sinking state, she can find a safe bed well up the loch, where her own pressure upon the soft mud would prevent the further flow of water, and enable her to discharge her cargo in a perfect "mill pond."

As a coaling depôt it is most admirably situated, as from the Clyde to the mouth of the loch *open vessels* might be towed in any weather *short of a heavy gale* with the most perfect security.

The Eastern Loch Tarbert is at present navigable to the quay where the steamer from Greenock lands her passengers and goods; but in order to adapt it still more completely for the passage of large vessels, it would be advisable to remove the protruding portions at the perch on the south side, and the buoy on the north (marking the limit of Cock Island), and to construct walls at both those points against which vessels might boldly touch their sides without incurring damage to their keels or bottom.

Two lighthouses would be necessary, one on the end of the quay wall, at Cock Island at A, the second within, at C. The latter, at C, should be sufficiently bright to guide a vessel from Ard Lamont Point, and enable her, by keeping the two nearly in line (dependent on northerly or southerly winds), to reach a secure berth, or pass through the channel.

Having completed my examination of the approaches easterly as well as westerly, I proceeded by steamer to Ardrisbaig, the southern entrance to the Crinan Canal, which I reached at dead low water on the spring tide. As the light steamer could barely get to the pier, it was very apparent that at that time of tide no vessel could enter the loch.

The first difficulty which presented itself at this low-water exposure of the rocks, was the *risk* which a vessel must incur by seeking the mouth of a canal, however well lighted, with a gale from the southward, which draws up this funnel-shaped loch with great force.

The complete lee shore and fetch of the whole sea of Loch Fyne would render it even an unsafe anchorage, and, at all times of low tide, or from the last quarter of ebb to the first quarter of flood, ranging between three and four hours, no vessel could enter, and the canal being locked, seldom would be attempted by night.

Having proceeded along the whole course of the canal to Crinan, and ascended a hill behind it, which commanded a full view of the adjacent loch and the seaward entrance, it required but little thought to discover the great difficulties which would attend any attempt at enlarging or improving this canal, independent of the complete stoppage of the small traffic which at present passes through it.

APPENDIX C.

SUPPLEMENT.

TARBERT.

No. 482.
Belcher, on the proposed Argyll Canal.

The extent of the Crinan Canal is 9 miles, and the rough *estimate* of forming a ship-canal, possessing *merely* the advantages which the Caledonian offers, is about 370,000*l.* Such estimates, and with such difficulties as I plainly foresee in *reconstructing* the Crinan, may be expected to be doubled before a vessel can pass. But the Caledonian would not admit H.M. steamer "Cuckoo;" and as the Crinan Canal is locked by 17 of these impediments to speedy transit, and the expense of increasing these obstructions increases somewhat about the ratio of the squares of their increased surfaces, it will be plain that the lock gates and their attendant works, independent of first cost, would become an alarming item of expense. If this canal be made available to our large war steamers, I deem the alteration of the Crinan, to meet this object, highly objectionable; a new canal by a more direct route would be less expensive; but, at the lowest calculation, to render it as available at all hours of tide as that proposed by Tarbert, half a million would not complete it.

The present locks of the Crinan are only 24 feet in width by 12 deep, not large enough to admit our smallest steamers, and the dues are so heavy that it is avoided, particularly by the class of vessels to which it ought to become most important, I mean to those pursuing the herring fishery.

Mr. Telford, in his Remarks on the Coasts and Central Highlands of Scotland, 1802, observes,—"I believe it is generally admitted that in the improvements of a country the interference of Government should extend only to the removing of obstacles and affording conveniences which are of a nature not easily to be surmounted by individuals, or any body of men who could be brought to act together, and where it is evident that by removing these obstacles and affording these conveniences the exertions of individuals will be greatly facilitated so as to promote the general good of the empire.

"Not to risk this by countenancing private speculation, which by levying heavier dues would mar these advantages in a public view."

These remarks, I think, bear strongly on the present dues on the Crinan, and on the difficulties which offer themselves to the speedy transit of the fishermen to the northern lochs.

Upon the subject of the fisheries he again remarks:—

"When, after the return of the Clyde vessels from a vain search for herrings in the northern lochs, some considerable shoals having appeared, intelligence was dispatched to Greenock, but owing to the indirect course of the post, and the difficulty of some parts of the circuitous journey, *several weeks elapsed* before any advantage could be taken of the information."

The Tarbert Canal will tend in a great measure to remove this difficulty; but it will also injure the Crinan if the dues on that canal are not more nearly assimilated. It is also highly probable that the free flow of the tide through West Tarbert Loch will induce the herrings to take up that loch (for Loch Fyne) instead of rounding the Mull of Cantyre; for it is a well-established fact that they always put their noses to the current and follow it up. Such a current will cross their track on their passage down the Sound of Jura.

But to return to the Crinan Canal:—

If any work of this nature, that is, of its construction *de novo*, and on a more direct line, should be contemplated, at the national cost, I would venture to suggest that no impediment should be offered to our largest steamers—that it should be unhampered by *lock gates of any description*. Nothing but a ship-canal can supply this desideratum.

The present Crinan Canal cannot maintain itself. It was constructed at an original cost of 183,000*l.*, viz., 108,000*l.* by the original propritors, and 75,000*l.* by Government.

After the test of 46 years from the date of its completion, it is found a complete failure; we are therefore justified in asking what is to repay this enormous additional expenditure?

Will it in anyway aid in the Clyde navigation, or will it entice any of the Irish, Western, or Atlantic trade to enter it by the north?—I think not.

In the year 1839, a Committee of the House of Commons reported, "That from the best information which they could obtain, it appeared that it is to the originally defective construction, and insufficient dimensions of the canal, that its failure must be mainly attributed."

"Your Committee have not been able to obtain any correct estimate of the sum that would be necessary to reduce the summit level and to deepen and widen the canal so as to render it navigable by the same class of vessels as frequent the Caledonian Canal. Your committee, however, entertain great doubts whether any great further outlay on this canal would be advisable, and they are strongly of opinion that it would not be so, unless the Caledonian Canal were first placed in a state of efficiency."

Now, to place the Caledonian Canal in the state of efficiency to meet the present as well as advancing state of steam navigation would double its original cost.

The final test, to which these two canals of Crinan and Tarbert should be put, appears to me a plain and direct matter of figures. Do any of the landed proprietors, interested in the Crinan line, offer any precise tonnage at present, or in prospect, to warrant such an expenditure?

On the other hand,—do the influential mercantile houses of Glasgow, Ireland, and intermediate island interests to which the Argyll Canal appears likely to become an important artery, offer any prospect or guarantee of tonnage to justify the outlay at Tarbert?

To the latter I think the annexed papers afford an answer, and the only further proof, if wanted, is that of the merchants of Glasgow having taken the risk of getting their Bill from Parliament to carry it out upon their own resources.

I have the honour to transmit documents, numbered from 1 to 13, bearing upon this report. The last received, on the 25th, points out more distinctly the advantages which will result between Islay and Glasgow, as well as to the interests of the proposed canal.

I now come to the conclusive reply to the subject submitted to my consideration:—

There is no objection to the navigation of, or to the approaches to, both Lochs Tarbert but what may be either avoided or removed at a trifling expense.

As to the comparative advantages between the Crinan Canal and that proposed as the "Argyll Canal," I have not the slightest hesitation in declaring that the Argyll Canal is not only the most important in a mercantile point of view—that it promises to secure immediate repayment—but that it is highly important to the national sea defences of western Scotland and Ireland, affording a sure and most convenient depôt for coaling, at the smallest cost, our steam fleet which may be stationed in that neighbourhood. Independent of these considerations, it promises to support and increase the number of that valuable class of Her Majesty's subjects, the fishermen, and to afford the surplus population other means of support than that immediately dependent upon the cultivation of land.

I cannot close this Report without expressing my sense of the obligation which I am under to Mr.

No. 482.
Belcher, on the proposed Argyll Canal.

Campbell, of Islay, and to Mr. Campbell, of Stonefield, in Cantyre, for the very great exertions which they have made to render my examinations complete, in their aid personally, by documents, steamboats, horses, men, and carriages, which I deem to be a service rendered to the Government.

Trusting that my proceedings will meet with their Lordships' approbation,

I have, &c.,

To the Secretary of the Admiralty. EDWARD BELCHER, *Captain, R.N.*

SIR, *Glasgow, April* 30, 1847.

PREFIXED is a copy of a letter which I shewed you, regarding the Argyll Canal, and I now inform you, that by this evening's mail I send you the following documents regarding the same business, and which are referred to in said letter, which I hope you will return to me after your purposes are served.

1st. Scroll plan and longitudinal section of the canal, to a scale of 400 feet to an inch for horizontal, and 60 feet for verticals.

2nd. Scroll plan on a scale of 100 feet to an inch.

3rd. Scroll section, longitudinal, on a scale of 100 feet to an inch for horizontals, and 30 feet for verticals; and

4th. Sheet of cross sections laid down to a scale of 30 feet to an inch.

I am, &c.,

Captain Sir Edward Belcher, R.N., THOMAS KYLE, *Land Surveyor.*
82, *Harley-street, London.*

DEAR SIR, *Glasgow, December* 11, 1845.

I NOW send you the enlarged plan of the Argyll Canal, with the sections of the same paper, and the depths of the borings marked on the cross sections and longitudinal sections: you will see that there is rock in the bottom of East Loch Tarbert, with a covering of muddy gravel above it. I think there will be further borings required, particularly of West Loch Tarbert, but of this you can best judge. The last boring was 32 feet in mud (being the whole length of the boring rods), without finding rock in the gut or deep channel; the bottom is pretty firm, being more of a clayey nature.

Spring tides in East Loch Tarbert rise from 10 feet to 10 feet 8 inches, which latter I have put on the section. The neap tides in this loch rise 4 feet 8 inches only. In West Tarbert there is no regularity of tides, as will be seen from the journal kept by Mr. Murray, a copy of which is herewith sent. The soundings in East Loch Tarbert are all reckoned from extreme low-water mark, or datum line, and those in West Loch are reckoned from low water in that loch, which is 3 feet 4 inches above datum.

On the 2nd November the high water in East Loch Tarbert was 1° 15″ p.m., and 9′ 10″ above datum, and at the same instant the water in West Loch Tarbert stood 4′ 4½″ only above datum.

The high water on the same day in the West Loch was at 6° 30″ p.m., and 6′ 4½″ above datum, and at the same instant of time the water in East Lock Tarbert stood at 9 inches above datum. I shall be happy to give you any further information in my power, and I hope you will forgive me for the delay that has taken place in furnishing you with the plans, &c.

I remain, &c.,

John Gibb, Esq. THOMAS KYLE.

Abstract of the Number of Boats, from 2 *to* 8 *tons burthen, and of the Entries of Vessels above that tonnage, which entered the Harbour of East Tarbert for Ten Years, ended July* 1, 1846.

	Years ending 1st July,	Boats from 2 to 8 Tons.	Entries of Vessels, 8 and not exceeding 20 Tons.	Entries of Vessels, exceeding 20 Tons.
	1837	397	48	309
	1838	510	75	367
	1839	631	88	492
	1840	458	67	397
	1841	564	50	338
	1842	506	45	380
	1843	502	38	412
	1844	561	85	451
	1845	369	58	424
	1846	320	70	465
Total . .		4,822	624	4035

April 23, 1847. D. SINCLAIR, *Harbour Secretary.*

APPENDIX C.

SUPPLEMENT.

TARBERT.

No. 482.
Belcher, on the proposed Argyll Canal.

Probable Estimate of the various Works required on the Argyll Canal.

		£.
1.	Land and houses	3,000
2.	Excavation of the Canal and deepening the West Dock	75,000
3.	Altering roads and constructing two turn-bridges	2,500
4.	Two regulating locks, with gates complete*	30,000
5.	Two steam-engines for pumping	1,500
6.	A dredging-machine and punts	4,000
7.	Two steam-boats for the navigation	6,000
8.	Two lighthouses	1,500
9.	Improving East Tarbert Harbour	3,500
10.	A diving-bell for ditto	500
11.	Harbour-master and lock-keepers' houses, with storehouses at each end	1,500
12.	Engineering and Parliamentary expenses	5,500
13.	Contingencies (10 per cent.)	13,450
	Total	£147,950

Aberdeen, December 27, 1845. JOHN GIBB.

Returns of Coasting Trade, obtained from Parties interested in the direct Navigation to Glasgow by the Argyll Canal.

SCOTCH TRAFFIC.

		Tons.
Easdale		17,500
Ballyhuillish		18,000
Ditto, for coals		2,800
Oban		51,724
Glenmore		840
Ditto		3,825
Jura		7,400
Colonsay		764
Skye (Sound of) and Rona		43,612
Lewis (1830)		4,378
North Cantyre and Gigha		10,433
Islay†		70,400
Tarbert Loch to Kilisfoot		4,501
Cattle and sheep	7,202 head	—
Mull, Tiree, &c.		46,800
Northern Islands, estimated		200,000
		482.977
†Additional for Islay (*See* below)		54,750
Total		537,727

In this return passengers are not included, except to Islay, and some deduction will be due for cattle and sheep from Tarbert Loch to Kilisfoot.

The tonnage given from Islay refers to a back period, previous to obtaining the Bill for this canal, and amounts to 70,400 tons.

By the following notes, received from Mr. Campbell of Islay, that tonnage will be very materially increased :—

"I have had an offer to give me not less than 5*s*. per ton for the raw limestone of Islay, the stone to be landed at the Broomielaw in Glasgow; if the stone is of the same quality as that sent, Messrs. Baird, Dixon, & Co. will take 150 tons a-day for 365 days in the year.

"If the canal is made, I shall be able to send this stone at the freight of 2*s*. 6*d*. per ton; the present freight (by the Mull of Cantyre) being from 4*s*. 6*d*. to 5*s*. per ton, none can be sent.

"This offer has been made to me since my return from London, and therefore this branch of traffic is not included in calculating the amount which pass through the canal

"W. T. CAMPBELL, *of Islay.*

Remark.—The spot where this limestone would be quarried is situated in the sheltered part of Islay Sound, where the limestone juts into the sea, forming a natural pier, which, with the first workings, would be extended so as to form a safe pier for the vessels to receive it from the quarries.

This lime is of equal importance to the ironmasters (for roasting their ores) as their coal, and would afford continuous and permanent employ to part of the population of Islay.

Independent of this, the late contracts taken for working the rich metalliferous veins will materially assist in this object, as well as furnishing additional tonnage by the canal, either by the transit of the ore or by the coal required for its reduction.

The following note was received from Mr. Campbell, on the 20th:—

DEAR SIR, *Coats House, April* 19, 1847.

I HAVE now the pleasure of sending you the result of the trial of your limestone. We weighed it, and found it exactly 18¾ tons, of 20 cwt. to the ton, and made with it 81⅓ tons of pig-iron, being 4 cwt. 2 qrs. 11½ lbs. to the ton of pig-iron, which, being compared with the Garnkirk and Bedlay

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* From conversations with practical engineers connected with this undertaking, these expenses may be deducted, as lock-gates are deemed superfluous.

APPENDIX C.
SUPPLEMENT.
TARBERT.
No. 482.
Belcher, on the proposed Argyll Canal.

limestone (which we are using at present), shows a saving of 3 cwt. 3 qrs. $16\frac{1}{2}$ lbs. In short, your limestone only requires 4 cwt. 2 qrs. $11\frac{1}{4}$ lbs. to the ton, where the others I have mentioned require $8\frac{1}{3}$ cwt.

However, I may state, that the furnace we tried your lime in was in good working order, and had the best of good clean mine, which gave your limestone rather more than a fair average trial.

If convenient, you may send us, say 200 tons more of it. We will not disagree about the price, and we shall give a further and most determined trial.

It requires a furnace to go at least 10 days on the same materials to give them a fair trial.

I am, &c.,
DOUGLAS BAIRD.

To Walter T. Campbell, Esq., Islay.

Irish Traffic.

	Tons.
Clyde and Derry	72,000
Sligo	67,380
Ballyshannon (coal)	577
Limerick	33,640
Total . . .	173,597

No passengers included in the Irish returns, nor live stock in that from Sligo.

Return of Traffic to and from the Clyde with Glenmore and Melforth.

EXPORT.		IMPORT.	
Cattle	200 head.	Coal	300 tons.
Sheep	300 ,,	Iron	2 ,,
Wool	2,000 stone.	Salt	2 ,,
Fish	100 barrels.	Oats, or meal . . .	100 barrels.
Bark	6 tons.	Guano	6 tons.
Potatoes	300 barrels.		
Whiskey	1,000 gallons.		

COLONSAY:

Traffic to and from	364 tons.
Cattle	400 head.

The passengers go by the Islay steamer.

Extract of the Trade between Sligo and Glasgow.

EXPORTS.		£.	IMPORTS.		£.
70,000	Pigs, slaughtered and made up	210,000	16,000	Barrels of herrings . .	16,500
10,000	Ditto alive . . .	25,000	9,000	Tons of timber . . .	27,000
7,000	Cattle, slaughtered, &c. . .	70,000	15,000	,, coal	9,000
1,200	,, alive . . .	12,000	4,000	,, iron . . .	32,000
100,000	Butter (firkins) . . .	250,000	5,000	,, slates . . .	12,000
22,000	Oats (tons)	132,000			
12,000	Oatmeal	132,000			£96,500
		£831,000			

It is calculated that the whole of this trade would pass through this canal.

Extract of Correspondence from Sligo, June 3, 1845.

Ballyshannon from Glasgow:—Exports, none.

Ten vessels under 100 tons, bringing 577 tons of coal.

"A cut through the isthmus, between East and West Tarbert, would be of great use to the shipping interest, as, with the wind at south or south-west, all the vessels from the Clyde bound to the west would go this route.

"The proposed canal would be of great use to this part of Ireland."

LEWIS.—Information obtained from J. M'Kenzie and Stewart Harris, Esqs.:—

"A steam-boat would have the whole of this traffic; the whole, or nearly the whole stock, would be sent by steam direct to Clyde were a canal cut at Tarbert; for after crossing the Minch, they would have smooth water the whole way by the Sound of Skye and Mull of Jura, and would make the passage in 16 hours."

This stock includes—

Coal	330 tons.	Cattle	400 head.
Barley	65 ,,	Sheep	1,000 ,,
Iron	4 ,,		
Groceries	1 ,,	Computed at . . .	1,000 tons.
Salt fish	67 ,,	Passengers	800
Wool	160 ,,		

The proposed length of the Argyll Canal is $1\frac{3}{4}$ miles, of which three-quarters of a mile is to be cut through a soft rock (mica schist), the proposed width (in the estimate) being 63 feet.

Remark.—As this width would not admit of the passage of large steamers, it is proposed to increase it.

No. 482.
Belcher, on the proposed Argyll Canal.

At each end a lock, or rather a double tide-gate, 56 feet wide, 250 feet long, and 18 feet deep at neap tides.

> *Remark.*—Locks unnecessary; the difference between the tides above or below the mean tide level being computed at only one foot, and this variable, entirely dependent on westerly winds.

The remaining part of the canal to be from 120 to 150 feet wide.

The capital of the company is 150,000*l.*, in 6,000 shares, of 25*l.* each; the whole deposit of which was paid on the day named by the committee.

The estimate for the whole expense, including steam-tugs, is about 100,000*l.*

(Extract from papers.) CAMPBELL *of Islay.*

Estimate of Tonnage from the Scotch and Irish Traffic alone, which would pass by the Argyll Canal.

	Tons.
Scotch coasting	482,977
Irish ,,	173,597
Lewis ,,	1,000
	657,574
Computed increase on limestone from Islay	54,750
Total	712,324

These calculations simply embrace the home trade to the Clyde. There is every reason to expect that when a safe channel once becomes established that this will at least be doubled.

No foreign or outward trade is included in this estimate, but it may be safely assumed at 200,000 tons; or the future tonnage, by the increase of daily steamers, will equal 1,000,000 tons.

No. 483.

Report by LIEUT.-COLONEL P. YULE, R.E., *on the proposed Argyll Canal.*

No. 483.
Yule, on the proposed Argyll Canal.

SIR, *Junior United Service Club, London, June 18, 1847.*

I HAVE the honour to inform you that, in obedience to the orders of the Lords Commissioners of Her Majesty's Treasury, as communicated to me in your letter of the 7th ult., to prepare a plan and estimate of a ship canal at Tarbert, I left London on the 9th, and stopped two days in Edinburgh for the purpose of procuring an assistant in the ordinary operation of making a survey of ground, but without success, persons so qualified being at present much wanted for private undertakings.

I did not think proper to delay longer on that account, as, by proceeding to Tarbert, I might in the mean time acquire some knowledge of the isthmus.

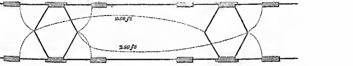
On my arrival there I met Lieutenant E. J. Bedford, R.N., now employed in the survey of the coast, who, with much zeal for the public service, kindly offered me such assistance as lay in his power; I was thus enabled to commence some necessary operations.

It had occurred to me, before I reached Tarbert, that owing to the geographical position of the peninsula of Cantyre, extending towards the north-eastern coast of Ireland, there would be a considerable difference in the time of high water on the eastern and western shores, as the tide approaches both from the Irish Channel and along the northern coast of Ireland; I therefore engaged two men to make simultaneous observations hourly during the day, of the rise and fall of the tide in the eastern and western lochs at Tarbert. That there was a difference, I found to be known in the vicinity, but its great amount is of considerable importance as bearing on the projected work.

I annex (in page 649) a copy of these observations, made on the 15th, 17th, 18th, and 19th ult. The tide is very irregular in the western loch; it often differs six hours from the eastern loch; and when to this circumstance it is added that low water in the former is 3 ft. 4 in. higher than low water in the latter, also that the tide sometimes rises 8 ft. 10 in. in the western loch, it is evident that with this occasional declivity of 12 ft. 2 in. in so short a distance, there will be a very rapid current.

It therefore appears indispensable to guard against such extremes of tide, even though they occur seldom, and I propose to have four flood-gates in the canal, two facing the eastern loch and two the western (fig. 5), each pair forming a lock of 250 feet in length.

The gates thus placed will meet the current in either direction, for it is to be observed that, when it is high water in the eastern loch and low water in the western loch, the current will flow towards the latter.



But the expense of the gates will be compensated by the advantages proposed to be derived from this current in assisting the operation of clearing the channel in the two lochs of the mud accumulated in them, more especially in the western loch. It will probably be sufficient to supersede the use of a dredging-vessel; for if the mud be loosened by manual labour, the current will carry it into the deep sea; and as deep water is nearer the eastern loch, the current should be allowed to run through it alone, keeping the gates shut when it sets to the west. It is certain, at least, that the channel, once cleared, will not be liable to the future accumulation of silt if the current be kept under control.

APPENDIX C.

SUPPLEMENT.

TARBERT.

No. 483.
Yule, on the proposed Argyll Canal.

In the estimate, the whole mass to be removed from the isthmus, to form a canal 56 feet wide, and 18 feet deep below low water, is calculated at 615,585 cubic yards, to be excavated by the process of blasting, although, from the nature of the adjoining ground, in which the rock lies in irregular forms, there will be a probable deduction of expense for earth. On the other hand, when earth is found, a sufficient slope must be given to the excavation, and a larger quantity be removed; the one kind of material may therefore be assumed to compensate for the other.

If earth be found between high and low water, the operation of excavating may be forwarded by cutting a narrow channel through the whole length of the canal, so as to let the current take effect in washing away the loose earth.

Part of the excavated rock may be disposed of on the shore of the eastern loch, and in filling up the space between the small islands, so as to afford accommodation to the fishermen of Loch Fyne, but the greater proportion of it will have to be removed to the western loch, where it might be deposited for the purpose of reclaiming a large space of ground between high and low water. The fig. 4 shows in what mode this may be done. The loose rock to be placed in two parallel lines, at the distance of about 240 feet; as the depth of soft mud is, at different places, about 32 feet, the rock, in taking the natural slope, will leave a breadth of about 150 feet for the channel. The surface of the reclaimed ground may be raised three or four feet above high water. By laying down the rock in rows, forming hollow squares of about 30 yards, the mud being confined will be forced up, and thus facilitate the operation of spreading a layer of soft soil for arable purposes.

A space of about 30 acres may be thus obtained, being about three times more than the surface of the proposed canal in the isthmus.

The direction of the canal is within narrow limits, owing to the nature of the ground on each side, (see lithographed plan and section, sec. i. x y); and it will be as straight as possible, consistent with economy of execution.

In conclusion, it may be observed, that when a work of this nature, formed in rock by mere force of labour, is once completed, it will be liable to no accidents; it will not require science to execute it, nor much money to keep it up; the lock-gates and their piers alone will be liable to deterioration by time.

have, &c.,
P. YULE, *Lieut-Colonel Royal Engineers.*

C. E. Trevelyan, Esq., &c. &c. &c.
Treasury.

The recent survey agrees so nearly with that previously made that it was unnecessary to make any alterations in the dimensions, excepting in the height of the tides; the greatest known rise is inserted in this Report.

Account of the Rock Excavation.

Above low water. (*See* Section 3.)		Length	Breadth.	Height.	Cubic Yards.
		Feet.	Feet.	Feet.	
From A to B	. . . .	98	56	13½	2,693
„ B „ C	. . . .	40	56	15	1,244½
„ C „ D	. . . .	212	56	17⅓	7,621½
„ D „ E	. . . .	50	56	21	2,178
„ E „ F	. . . .	50	56	27½	2,852
„ F „ G	. . . .	100	56	32½	6,740½
„ G „ H	. . . .	100	56	38	7,881½
„ H „ I	. . . .	702	56	39	56,784
„ I „ K	. . . .	598	56	42	52,092
„ K „ L	. . . .	740	56	47½	72,520
„ L „ M	. . . .	680	56	50½	70,871
„ M „ N	. . . .	400	56	49	40,652
„ N „ O	. . . .	100	56	42	8,814
„ O „ P	. . . .	100	56	35½	7,363
„ P „ Q	. . . .	100	56	28½	5,911
„ Q „ R	. . . .	200	56	23½	9,748
„ R „ S	700 × 56 × 15½ = 22,503 150 × 56 × 6½ = 1,970				
	24,473	..	..	..	24,473
Triangle A.S.T.	5,765 × 56 × 3½ = 19,920	..	..	..	19,920
					400,359
Below low water.		5,765	56	Depth. 18	215,226
				Total.	615,585

June 18, 1847.

APPENDIX C.
SUPPLEMENT.
TARBERT.
No. 483.
Yule, on the proposed Argyll Canal.

Simultaneous Observations on the Rise and Fall of the Tides in the Eastern and Western Lochs, Tarbert, taken hourly, between 6 a.m. and 6 p.m., on the 15th, 17th, 18th, and 19th May, 1847.

Date and Time of Day.	Height above Low Water, Eastern Loch.		eight above Low Water, Western Loch.		Actual Level of Eastern Loch ab Western Loch.		Actual Level of Western Loch above Eastern Loch.	
	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.
6 a.m. (15 May)	0	10	6	9	..		9	3
7 ,, . . .	2	6	1	10½	..		2	8½
8 ,, . . .	4	4½	2	0	..		0	11¼
9 ,, . . .	5	10	1	4½	1	1½	..	
10 ,, . . .	7	6	1	0	3	2	..	
11 ,, . . .	9	1½	0	10½	4	11	..	
12 ,, . . .	9	10	1	2	5	4	..	
1 p.m. . . .	9	8	3	2	3	2	..	
2 ,, . . .	8	2	4	0	0	10	..	
3 ,, . . .	5	10	3	6	..		1	0
4 ,, . . .	3	5	3	7½	..		3	6½
5 ,, . . .	1	0	3	6	..		5	10
6 ,, . . .	0	4	4	0	..		7	0
6 a.m. (17 May)	1	3½	2	7½	..		4	8
7 ,, . . .	0	8	3	4½	..		6	5½
8 ,, . . .	1	0	1	9	..		4	1
9 ,, . . .	3	0	1	0	..		1	4
10 ,, . . .	4	8	0	10	0	6	..	
11 ,, . . .	6	2	0	8	2	2	..	
12 ,, . . .	7	10	0	7½	3	10½	..	
1 p.m. . . .	9	0	0	6	5	2	..	
2 ,, . . .	8	10	2	0	3	6	..	
3 ,, . . .	8	6	8	6	1	8	..	
4 ,, . . .	7	1	3	9	same level in both lochs.			
5 ,, . . .	4	9	4	0	..		2	7
6 ,, . . .	2	6	3	6	..		4	4
6 a.m. (18 May)	2	3	2	0	..		3	1
7 ,, . . .	0	5	2	3	..		6	2
8 ,, . . .	0	1	2	6	..		5	9
9 ,, . . .	1	4	1	3	..		3	3
10 ,, . . .	3	0½	0	9	1	0½	..	
11 ,, . . .	4	5½	0	6	0	7½	..	
12 ,, . . .	6	0	0	3	2	5	..	
1 p.m. . . .	7	8½	0	2	4	2½	..	
2 ,, . . .	8	9	0	4	4	11	..	
3 ,, . . .	8	11	1	11	3	8	..	
4 ,, . . .	7	6	3	6½	0	7½	..	
5 ,, . . .	6	5	8	9	..		0	8
6 ,, . . .	4	2	3	0	..		2	2
6 a.m. (19 May)	5	0	3	2	..		1	6
7 ,, . . .	3	3	2	7½	..		2	8½
8 ,, . . .	1	5	3	6	..		5	5
9 ,, . . .	1	4½	2	7	..		4	6½
10 ,, . . .	2	5	1	9	..		2	8
11 ,, . . .	3	9½	1	9	..		1	3½
12 ,, . . .	5	4	1	3	0	9	..	
1 p.m. . . .	6	11	1	11¾	1	8	..	
2 ,, . . .	8	6	1	6	3	8	..	
3 ,, . . .	9	4	2	4½	3	5½	..	
4 ,, . . .	9	4½	3	3	2	9½	..	
5 ,, . . .	8	6	4	7	0	7	..	
6 ,, . . .	7	0	4	9	..		1	1

Estimate of the probable Expense of forming a Canal in the Isthmus, Tarbert.

	£.	s.	d.
1. Rock excavation, 56 feet wide, and 18 feet deep below low water, 615,585 cubic yards, at 2*s*. 6*d*. a yard	76,948	2	6
Contingencies, one-tenth	7,694	16	3
2. Four flood-gates and their piers	6,000	0	0*
3. The purchase of land and houses, altering roads, steam engines for pumping during the process of excavation, lock-keeper's house and store-houses, lighthouses, as estimated for the Argyll Canal Company, at	10,000	0	0
4. Forming the surface of the reclaimed ground in Western Loch, 30 acres in extent, being nearly 150,000 square yards, at 1*d*. a yard	625	0	0
Total . . £	101,267	18	9

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[*] Some gates of a large size, and on a new principle of construction, have been lately adopted in the Dockyard at Woolwich, where I shall ascertain the precise cost.

No. 484.
Rennie's proposed Improvements on the Plan for a Dock in the River Clyde.

GLASGOW.

No. 484.

Report and Plan by John Rennie, Esq., *with Improvements on the Plan for a Dock in the River, also his opinion of one in* Mr. Reid's *Ground, and Estimate.*

My Lord Provost and Gentlemen, *December* 26, 1807.

In consequence of your directions I have again examined the plan proposed for wet docks at the Broomielaw, and have heard the objections urged against this plan by sundry proprietors of houses residing on the side of the river Clyde above the new bridge, relative to the effect this plan would probably have in damming up the water in times of flood, and thereby inundating their house; and although I am confident that no such effect would be produced by the constructing of such a dock, yet, as it is the wish of your Lordship and the magistrates that every possible precaution should be taken, not only to remove all danger, if any exists, respecting the effects of such a dock, but that such alterations should be made as to remove from their minds every fear that can well exist, I have, therefore, conformable to such directions, made various alterations in the plan, and which I shall now submit to your consideration.

The objections I apprehend may be comprised under the following heads :—

1st. That as the new bridge has already too little water-way, it would be a serious obstruction to the floods if one of the arches, namely, that on the north side, were to be in part shut up by the lock that is intended to communicate between the proposed wet dock and the river above the new bridge.

2nd. That as the dock would extend a considerable way into the river, it would present a perpendicular wall to the current, which would throw the water in part over to the south side, occasion eddies, and thereby obstruct the passage of the floods to seaward.

3rd. That even admitting the new proposed channel to be of larger capacity than the present, that for the same cause as the floods are now greater than they were some years since they will continue to increase, and as agricultural improvements advance on the banks of the Clyde of course greater capacity will be wanted at some future period than is now requisite.

4th. That if, after the dock is made, it shall appear on trial that vessels lying in it shall experience inconvenience or injury from the floods passing over the top of the south wall, that Parliament will be more likely to grant powers to raise this wall than they would now be, and that, therefore, although they might not be injured by the plan as proposed, they would ultimately be materially injured by the raising of this quay wall above the height of floods. And,

Lastly. That the weir below the new bridge acts as a dam, and prevents barges from passing over it, which formerly used to navigate the river as far up as Rutherglen, besides occasioning mud to settle in the bottom of the river, and thereby rendering it more shallow.

In respect to the first objection, no doubt can remain on any person's mind, that by shutting up a part of the north arch the capacity of the water-way of the bridge will be diminished according to the space so occupied; but, although this is true; yet, when it is considered that by removing the bank of earth on the south side, a greater capacity will be given on the whole than there now is, and the vessels that now lie in crowds at the quay of the Broomielaw, and which act in part as a dam and occasion eddies in the current, will be removed in a great degree into a space which is now solid ground. A more free passage will by this means be afforded for the carrying away of the floods than there now is. The stopping up of the north arch in part will, therefore, be less detrimental than the bank of the river on the south side, the more especially as the water-way of the new bridge is larger than the old.

2nd—The dock, no doubt, as far as it would extend, would present a perpendicular face to the current, but this would stand in a slanting direction, and although higher than the south bank, is by no means so extensive; the eddy, therefore, that would be formed by this wall would not be so great as that formed by the present bank and jetties.

The third objection carries apparently some weight with it; but the fact is, that the floods, as they now are, cannot keep the bank to the level it was made some years since. Mud is constantly settling upon it, and its surface is rising. A very considerable addition to the height of floods, would, therefore, be requisite to keep it in its present state; and as, by the wet dock, the current of the river would be forced to pass through the arches nearly at right angles to the line of the bridge, instead of running so obliquely as it now does; the water would, therefore, pass through the openings with a greater velocity, and be more likely to keep the new channel open than in its present state; this, of course, allows for a considerable increase of flood, without inundating the houses above.

As to the fourth objection, I think this merits little consideration; as, if the floods were found inconvenient to the trade, it would be an easy matter to raise a wharf or stage on pillars above the height of ordinary floods, and thereby enable the trade to be carried on with very little interruption indeed.

The last objection is perhaps founded more on conjecture than fact. That a weir or dam across a river, generally speaking, forms an obstruction to the passage of the water, cannot admit of a doubt; but whether this low dam has been the means of injuring the navigation upwards, I think, will admit of considerable doubt. I have no well-authenticated information respecting the kind of barges that have been alleged to navigate up the river to Rutherglen previous to the erection of the new bridge, of the weir across the river or of the improvement of the navigation below; but, as far as the documents in the Chamberlain's office will bear me out, and as far as any other information I have been able to collect will go, I have reason to believe that the weir has not rendered the navigation upwards worse than it formerly was, nor has it been the means of lessening the depth of water in the channel of the river.

There is in the Chamberlain's office the original plan of the new bridge, which was made in the year 1775, on which the section of the river is drawn, and by measuring the depth of the channel below the springing stones of the arches, it appears that the top of the weir is as low as the original bed of the river; and by soundings which I have taken from the new bridge to the timber bridge, it appears that there is generally much less depth of water when the tide is up in the channel of the river than on the top of the weir below the new bridge. That some mud may have subsided in the channel I will not venture wholly to deny, but this must be very little, and cannot extend for any considerable distance upward. I think, therefore, I am warranted in concluding that the navigation of the Clyde to Rutherglen has not been materially, if at all, affected by the weir in question; and, of course, any

APPENDIX C.

SUPPLEMENT.

GLASGOW.

No. 484.
Rennie's proposed Improvements on the Plan for a Dock in the River Clyde.

action or suit that may be brought against the magistrates of Glasgow, to oblige them to remove the whole or part of the weir, cannot be sustained.

To anticipate the probability of the floods of the Clyde increasing in height, as the agricultural improvements of the ground on each side of it, and draining into the river, as noticed in my Report of the 22nd of August, 1799, I propose that a wet dock be constructed at the Broomielaw, being partly in and partly out of the river, and that the head of this wet dock shall be placed at the distance of 350 feet from the down-stream side of the new bridge, and that the upper wall of the quay shall be slanted off so as to join the present quay wall of the Broomielaw 150 feet below the bridge.

The dock itself I propose to place 30 feet farther into the land than the former plan, and the channel may be made 10 feet wider to the south, thus leaving 40 feet more for the new channel on the south side.

The dock to be of the same dimensions as formerly, namely, 1350 feet long and 160 feet wide.

I propose that a new weir shall be built across the river below the new bridge, in place of the present, and that this weir shall be at least 1 foot lower at its top than the present weir, and so constructed as to carry the water in a more regular manner, and in a slanting direction to the bed of the new proposed channel. This will prevent the falling of the water over the weir on the bed of the river, so as to occasion the throwing up of gravel, as it now does in a partial manner, and thereby obstructing the current. By this plan the whole openings of the bridge will not only be preserved but greatly increased. No lock is intended at the head of the dock, as it is evident opportunities will be thus afforded of barges passing over the weir at an earlier period of the tide than they now can do, and will thus give them an opportunity to pass up the river, if the depth of water shall admit.

I would fain hope that no objections will be made by those who were adverse to docks at the Broomielaw to the plan now proposed, at least, if any are, they must, in my opinion, be totally groundless; for by it the floods will be more speedily carried off than they now are, and the capacity given to the bridge will anticipate any probable increase of floods that are likely to take place for a very long period to come.

Besides the plan here proposed, I have examined another piece of ground which lies on the north side of the river, where a dock may be made entirely out of its channel.

This piece of ground is bounded by the Anderston-road on the north; by New-street, extending west from the Broomielaw on the south; by the back of the houses in Alpine-street on the east; and by those of Clyde-street on the west. On this piece of ground a dock may be constructed of 870 feet in length by 200 feet in width, with a lock to communicate with the Clyde, as represented in the plan. This dock will cover about four English acres with water.

I propose a quay on the west side, of 100 feet wide near the south end, and 135 feet next the Anderston-road, to be used for the purpose of discharging or loading vessels of which the cargoes are not to be deposited in warehouses adjoining the dock, or for receiving goods or other articles that come from warehouses in the city, or other places. Also for the coal trade, &c. &c. The end next Anderston-street and the Clyde may also be used as a common wharf.

On the east side I propose a quay of 100 feet in width, with warehouses to be built on the vacant ground, extending from the side of the wharf to Alpine-street. In these warehouses all bonded goods and other valuable merchandise, or corn and provisions, &c., may be deposited. They may be put into the warehouses, when inspected, direct from the quays, and for this purpose a shed should be made on the quay for ganging or weighing them when landed; and when to be taken away for consumption, they may be put into carts on the side next Alpine-street. If brought for exportation, they may be put into the warehouses in Alpine-street, and taken out on the quay side, if they are to lie for any time waiting, or if part of the bonded goods are to be shipped. If not to be deposited in warehouses, they may be deposited under the sheds on the quay until shipped.

A dock constructed on this ground will not be so near to the heart of the city as that proposed at the Broomielaw, nor will it be of so great a capacity; but it will be a very complete thing of its size, and may be made at much less expense than the other, and as no alteration will, in this case, be necessary on the present navigation, so far as this dock is concerned, it will be for your Lordship and the magistrates to consider whether it will be proper to improve the river upwards, by removing the present weir and building one of less height.

If such a dock is made, the Broomielaw will be left open to those who may choose to frequent it. But I am persuaded, from the experience I have had in wet docks, and this is not inconsiderable, that, when their advantages are known, few vessels will resort to the Broomielaw.

Although a lock will be saved at the new bridge by the plan now proposed for a wet dock, partly in the river and partly out of it, yet, as the new channel will be of larger capacity than that formerly proposed, and as there will be more earth to excavate, some part of which cannot be deposited between the walls of the south quay, it must be carried to a distance; and therefore I do not think it can be made for less money than was formerly estimated; besides, the new weir will be an addition to this expense; but this ought to come off the present river funds, and not out of the new funds to be provided for a wet dock.

The dock which is proposed to be made on the piece of land lying between Anderston-street and the Clyde will cost nearly as much as one on Windmillcroft. I cannot pretend at present to estimate this expense very correctly, not having the levels of the ground. Nor do I know where the earth that comes out of the dock can conveniently be laid. It must either be carried across the Anderston-road, and deposited on Windmillcroft, or some place near it. In either case, the expense of removing the earth will be considerable, and render the estimate of this small dock greater than might be imagined, and which I cannot well state at less than 32,378*l.*, exclusive of a dry dock, and of the purchase of the ground. The dry dock will cost about 2532*l.*, as stated in my last estimate. The value of the ground I am not able to estimate.

I am, &c.,
JOHN RENNIE.

The Right Hon. the Lord Provost and
Magistrates of the City of Glasgow.

APPENDIX C.

SUPPLEMENT.

No. 484.
Estimate of a Wet Dock between Anderson Road and River Clyde.

Estimate of a Wet Dock proposed to be made on the piece of vacant Ground lying between the Anderston Road and the River Clyde, as shown on the Plan. The Dock to have 13 *feet water.*

	£.	s.	d.
To 18,814 cubic yards of earth to excavate, at 1*s*.	9,390	7	0
10,800 ditto in lowering the quay, at 1*s*.	510	0	0
8,800 ditto of masonry in quay walls, at 16*s*.	7,040	0	0
2,140 running feet of coping extra, at 1*s*.	107	0	0
2,140 ditto of plank under toe of wall, at 1*s*.	214	0	0
6,000 cubic yards of puddling, at 7*d*.	175	0	0
13,140 ditto filling in behind the walls, at 6*d*.	328	10	0
An entrance lock	5,000	0	0
10,500 yards excavation for ditto, at 1*s*.	525	0	0
700 cubic yards of wings, at 17*s*.	595	0	0
Swivel bridge across the lock	500	0	0
Mooring posts	150	0	0
Steam-engine and coffer-dam at entrance	2,500	0	0
24,000 square yards of paving, at 2*s*.	2,400	0	0
Contingencies	2,943	3	0
	£32,378	0	0

A dry dock, as before estimated, £2532.

PORT GLASGOW.

PORT GLASGOW.

No. 485.

No. 485.
The Provost, on the constitution of the Harbour Trust.

Extract from a Letter from the Provost and Town Council of Port Glasgow, to the Secretary of the Tidal Harbours Commission.

December 1, 1846.

THE harbour here is placed under very injudicious management. The trustees now consist of no fewer than sixty-one individuals, of whom fifty, composing the Town Council of Glasgow (a fluctuating body), reside there, and have no connexion whatever with, or any interest in, the prosperity of the town or harbour of Port Glasgow.

A. FALCONER, *Provost.*

SOLWAY FIRTH.

SOLWAY FIRTH.

No. 486.

No. 486.
Robinson, on the Buoying and Lighting of the Solway Firth.

Report of Captain CHARLES ROBINSON, R.N., *to the Admiralty, on the Buoying and Lighting of the Solway Firth.*

SIR,

Surveying Service, Largs, March 16, 1847.

I BEG to acknowledge the receipt of your letter of the 12th instant, respecting the completion of the buoyage and beaconage in the Solway Firth. I have to state, that I consider the English Channel of the Solway both well lighted and buoyed; but the Scotch shore would be very greatly improved by a small light on Hestan Island, thereby affording a guide to the numerous vessels that run for shelter into the Bay of Balcarry at tide time, as well as the Waters of Urr, both of which places offer good shelter, when obliged to bear up against the prevailing south-west wind.

This light, and a good bell-buoy on the spit of the Two-feet Bank, off the south-west end of the Dumroof Bank, is all that I think is required in addition to the buoys already placed.

I have, &c.,

CHARLES G. ROBINSON, *Captain.*

To Rear Admiral Beaufort, Hydrographer, Admiralty.

No. 487.

No. 487.
Cunningham, on additional Lights and Buoys on the Coasts of Scotland.

Extract of a Letter from ALEX. CUNNINGHAM, Esq., *Secretary to the Board of Northern Lights, relative to additional Lights and Buoys on the Coasts of Scotland.*

June 23, 1847.

BUOYS have been recently moored in the Moray Firth, and the Commissioners are constructing two beacons for Otter Point, in Loch Fyne, and a beacon to mark the sandbank in Loch Ryan.

They have resolved to erect, and are now constructing, a beacon in Holm Sound, Orkney, and the engineer is about to survey these shores with a view to complete the system.

In addition to these, the Commissioners are erecting lighthouses at Nosshead, in Caithness, and Arduamurchan, on the west coast.

They have also resolved to erect the following lighthouses:—

1. Kyle-Akin, to open the Sound of Skye.
2. Lochindaal, Islay, to lead to that anchorage.
3. Devaar Island, to lead to Campbelltown Harbour.
4. Sanna, off Kintyre, with a beacon on Patterson's Rock.
5. Two lights on Græmsay, in Orkney, to open Stromness anchorage.

ALEX. CUNNINGHAM, *Secretary.*

No. 488.

Note by Captain VETCH, R.E., *on forming a Harbour of Refuge at Dunbar*, 1847.

No. 488.
Vetch, on forming a Refuge Harbour at Dunbar.

ADMITTING the locality of Dunbar to have many claims to be selected for the construction of a national harbour, to which trading vessels might run for shelter at all times of the tide, and where they might advantageously wait for a wind, and also to be a favourable rendezvous and refuge for the boats of that valuable fishing station, I much fear that the exposed locality and comparative small available extent of harbour area would prove quite unsuitable to the construction of breakwaters on the principle of that in Plymouth Sound and in Dublin Bay; nor do I conceive that the outlying rocks would prove of any great use as abutments to such a structure.

These detached rocks lie in irregular lines, and are probably the remnants of great trap dykes, and though not exactly arranged in the form most desirable for the outline of a harbour, they must nevertheless dictate the form, as they can neither be left outside nor be taken inside without much inconvenience.

It is, however, so far fortunate that the series of rocks which define the proposed west harbour, of about 38 acres, are by no means ill-disposed in point of form, and if, abandoning the principle of breakwaters with long sea slopes (above objected to), upright structures be adopted, there is no doubt, in that case, they might form valuable abutments; and I have seen no where more favourable conditions for applying the mode of structure, the principle of which I have explained in "Weale's Quarterly Papers on Civil Engineering, for January, 1844," and which, I conceive, may there be carried out with comparative ease and economy; and failing these requisites, which do not attend the old methods of construction, it is to be feared that the coasting trade and the fisheries will long remain deprived of the benefit of useful shelter at Dunbar and elsewhere.

JAMES VETCH.

No. 489.

Account of Money expended between the Years 1807 *and* 1824, *by the Commissioners of Highland Roads and Bridges, under the "Act for applying certain Balances arising from the Forfeited Estates in Scotland, towards making Canals, Harbours, and other Public Works there."—46 Geo. III., cap.* 155.

No. 489.
Money Expended by the Commissioners of Highland Roads, &c., on Scottish Harbours, 1807-24.

Scottish Harbours.	£.	s.	d.	Scottish Harbours.	£.	s.	d.
Avoch—Beauley Frith	527	17	0	Kirkwall	1,972	2	2
Balintraed ,,	1,166	7	9	Kyle Rhea Piers (Skye)	585	10	0
Banff	7,973	10	0	Peterhead North Harbour	11,572	4	0
Burghhead	2,000	0	0	Peterhead South Harbour	3,900	0	0
Chanonry Pier	646	2	0	Nairn	1,862	10	10
Cullen	2,070	9	7	Portmaholmack	1,584	9	2
Dingwall Canal	1,904	2	1	Portree (Skye)	346	4	8
Fortrose	2,007	13	3	St. Catherine's Pier (Loch Fyne)	83	10	0
Fraserburgh	5,277	17	7	Tarbet (Loch Fyne)	863	11	9
Gourdon	994	18	8	Tobermory	1,455	5	4
Invergordon Piers	819	14	0				
Jura, Small Isles Pier	373	10	0	Total amount expended on Scottish harbours	£50,106	6	3
Kiells, Ferry Pier	118	16	5				

This aid was only granted on condition of an equal amount being expended by the applicants.

The Convention of Royal Burghs of Scotland paid towards the improvement of Scottish harbours, between the years 1700 and 1815, the sum of 10,998*l.* 1*s.* 3*d.*

Among others, the following harbours received aid:—Banff, 400*l.*; St. Andrews, 600*l.*; Dingwall, 600*l.*; Fortrose, 631*l.*; Kirkwall, &c.

No. 490.

An Account of the Number and Tonnage of Vessels (Coasting and Over Sea) that paid Dues to the Board of Northern Lights, for the Year 1846, *distinguishing the Lights for which the Dues were paid.*

Lighthouse.	Number of Vessels.		Tonnage.		Lighthouse.	Number of Vessels.		Tonnage.	
	Coasting.	Over Sea.	Coasting.	Over Sea.		Coasting.	Over Sea.	Coasting.	Over Sea.
Inch Keith	15,872	2,664	1,238,057	294,546	Barra Head	699	1,821	59,517	466,010
Isle of May	20,101	8,349	1,843,210	383,516	Skerriavore	555	1,788	52,511	461,313
Bell Rock	14,610	4,485	1,299,875	632,328	Lismore	2,430	34	159,719	4,436
Girdleness	7,915	3,978	788,947	587,977	Rhinns of Islay	3,162	1,550	385,786	382,841
Buchan Ness	5,293	4,012	419,988	590,453	Mull of Kintyre	6,023	1,440	509,914	357,682
Kinnaird's Head	4,829	2,819	390,166	546,856	Pladda	12,372	1,937	1,403,359	450,849
Tarbet Ness	2,356	273	191,345	18,282	Corsewall	12,453	2,776	1,407,921	645,447
Sumburgh Head	279	644	32,149	113,598	Mull of Galloway	12,884	2,453	1,648,915	531,056
Start Point	807	2,326	33,710	628,547	Little Ross	5,195	98	729,918	17,431
Pentland Skerries	2,434	2,430	181,284	525,582	Point of Ayre	9,733	1,034	843,235	209,237
Dunnet Head	1,911	2,267	139,379	624,685	Calf of Man	13,867	2,559	1,769,475	546,244
Cape Wrath	1,700	2,231	131,138	517,333	Covesea Skerries*	1,592	198	130,026	14,288
Island Glass	1,734	1,153	137,060	226,941	Total	159,196	50,324	15,926,634	9,577,478

* Covesea Skerries, Cromarty, and Chanonry, were not lighted until the 15th May, 1846; and Loch Ryan not till the 3rd March, 1847.

No. 491.

Table showing the aggregate Charges levied on Shipping and on Goods respectively, for the Years 1844–5–6; *the Debt* due on th
Loaded or in Ballast (Coastwise, and from British Colonies, and Foreign); and of the Vessels Registered in 1846,

Port, Harbour, &c.	1844				1845				
	Amount of Dues levied.			Debt due 31st Dec.	Amount of Dues levied.			Debt due 31st Dec.	Gross Receipts of Customs Duty
	On Shipping.	On Goods.	Total.		On Shipping.	On Goods.	Total.		
	£. s. d.	£. s. d.	£. s. d.	£.	£. s. d.	£. s. d.	£. s. d.	£.	£. s. d.
Aberdeen	3,772 8 3	13,033 16 6	16,806 4 9	177,820	5,651 10 9	13,195 18 3	18,847 9 0	186,676	75,97[illegible] 6 [illegible]
Boddam	6 9 9	34 0 8	40 19 5	..	4 16 10	33 6 3	38 3 1	..	..
Catterline	Nil.	Nil	Nil.	..	..	..	..	..	..
Newburgh*	135 16 6	16 16 6	152 13 0	..	172 8 0	19 18 6	192 6 6	..	..
Peterhead	674 10 11	2,357 19 4	3,032 10 3	34,975	719 16 11	2,572 1 2	3,291 18 1	33,876	..
Stonehaven*	93 9 9	254 3 7	347 13 4	..	117 12 9	319 18 3	437 11 0	..	..
Alloa (a)	208 0 0	492 0 0	700 0 0	..	209 0 0	515 10 0	724 10 0	..	1,470 15 [illegible]
Cambus (a) §	..	..	25 0 0	..	..	..	11 0 0	..	..
Clackmannan (a)	Nil.	Nil.	Nil.	..	..	..	..	..	..
Kennetpans (a)	Nil.	Nil.	Nil.	..	..	..	..	..	..
Kincardine (b)	30 0 0	40 0 0	70 0 0	..	30 0 0	35 0 0	65 0 0	..	..
Stirling (a) ‖	..	..	350 0 0	2,259	..	..	350 0 0	1,600	..
Fallin (a)	Nil.	Nil.	Nil.	..	..	..	..	..	..
Arbroath*	1,534 9 8	2,025 9 0	3,559 18 8	51,226	1,711 1 3	2,221 18 0	3,032 19 3	53,514	3,361 16 7
Ayr*	1,458 14 0	272 18 1	1,731 12 1	2,630	1,493 4 1	360 1 1	1,853 5 2	2,171	30[illegible] 14 9
Dunure	Nil.	Nil.	Nil.	..	..	..	..	..	..
Girvan	55 6 0	..	55 6 0	..	75 8 1	..	75 8 1	..	..
Banff (c) (g)	9 0 0	8 18 9	678 18 9	8,110	8 13 3	5 0 8	674 13 11	8,201	1,508 9 1
Buckie*	20 2 5	13 5 3	33 7 8	..	23 11 5	8 17 (	32 8 5	..	..
Fraserburgh*	607 2 0	1,220 4 3	1,827 6 3	5,196	687 0 11	1,210 5 1	1,897 6 0	12,496	..
Gardenstown* (g)	14 13 6	68 3 3	82 16 9	..	12 19 1	66 11 0	79 10 1	..	..
Garmouth*	60 0 0	..	60 0 0	..	70 0 0	..	70 0 0	..	..
Blackpots	3 0 0	..	3 0 0	..	3 10 0	..	3 10 0	..	..
Cullen*	33 2 0	69 0 0	102 2 0	..	37 0 0	77 8 0	114 8 0	..	..
Portsoy*	100 10 0	256 3 4	356 13 4	..	108 10 0	345 0 0	453 10 0	..	..
Whitehills*	13 5 11	13 8 1	26 14 0	..	12 11 7	14 0 1	26 11 8	..	..
Macduff § (g)	..	..	270 19 5	..	..	..	241 0 0	..	..
Pitullie*	25 0 6	4 12 2	29 12 8	..	24 17 4	6 11 0	31 8 4	..	..
Port Gordon †	21 10 9	128 10 10	150 1 7	..	22 16 4	124 17 1	147 13 5	..	..
Rosehearty (i)	..	..	..	..	..	..	..	..	..
Borrowstowness	122 13 2	123 5 11	245 10 1	2,507	125 4 9	210 11 7	335 16 4	2,400	1,335 1 5
Bridgeness (e)	158 2 8	..	158 2 8	..	123 15	..	123 15 0	..	..
Brucehaven § (a)	..	..	30 9 1	..	..	..	9 11 10	..	..
St. David's	Nil.	Nil.	Nil.	..	..	..	..	..	..
Inverkeithing	86 15 4	179 15 3	266 10 7	..	86 1 7	183 2 0	269 3 7	..	..
Charleston (f)	232 14 6	291 9 4	524 3 10	..	195 5 9	295 1 4	490 6 6	..	..
Campbelltown ‖ (h)	..	..	141 17 0	1,395	..	..	180 0 0	1,395	91 6 4
East Tarbert (d)	109 7 2	..	109 7 2	..	103 19 9	..	103 19 9	..	..
Islay (a)	..	..	..	..	..	..	..	..	..
Dumfries	264 5 4	947 18 3	1,212 3 7	5,603	289 7 10	1,144 10 5	1,433 18 3	5,005	10,416 5 1
Annan ‖ (a)	..	..	1 10 0	..	..	..	1 10 0	..	..
Lights and Buoys in the Solway Firth	321 6 8	..	321 6 8	..	243 12 5	..	243 12 5	..	..
Baldoon	12 17 0	..	12 17 0	..	15 1	..	15 1 0	..	..
Barlochan	Nil.	Nil.	Nil.	..	4 9 8	..	4 9 8	..	..
Carse-thorn	☞	..	..	..	10 1 10	34 10 0	44 11 10	..	..
Carty	20 0 0	..	20 0 0	..	17 4 6	..	17 4 6	..	..
Creetown	Nil.	Nil.	Nil.	..	..	..	..	..	..
Garlieston	33 10 0	74 10 0	108 0 0	565	35 12 0	79 8 0	115 0 0	555	..
Gatehouse (a)	32 1 0	..	32 1 0	..	35 16 1	..	35 16 1	..	..
Kirkcudbright	89 4 4	..	89 4 4	..	81 17 4	..	81 17 4	..	..
Port William*	69 18 1	85 11 1	155 9 2	..	69 15 2	89 15 8	159 10 10	..	..
Whithorn ‖ (a)	..	..	‡ 118 0 0	..	..	..	110 0 0	..	..
Wigtown ‖	..	..	55 5 0	..	..	..	81 2 6	..	..

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* The charge on shipping includes pilotage.
† Pilotage charges only.
‡ The Return for 1846 includes pilotage and anchorage dues.
§ The Return does not distinguish dues levied on shipping from those on goods.

‖ Harbour dues leased out.
☞ Return defective.
(a) Arrivals (coastwise) in cargo only. [See *Note*, p. 659.]
(b) Many vessels take shelter, but no account is kept.

No. 491.

st Dec. of those respective Years; the gross Receipts of Customs Duty for 1845–6; and the Number and Tonnage of Arrivals, whether
e several Ports and Harbours of Scotland, and at Berwick-upon-Tweed; distinguishing Sailing Vessels from Steamers.

1846														
Amount of Dues levied.			Debt due 31st Dec.	Proportion of Debt to Income.	Gross Receipts of Customs Duty.	Number and Tonnage of Arrivals, whether Loaded or in Ballast (Coastwise, British Colonies, and Foreign), and of Vessels Registered at the Port.								Description of Vessel.
On Shipping.	On Goods.	Total.				Arrivals.				Vessels Registered at the Port.				
						Coastwise.		Brit Colonies and Foreign.		Under 50 Tons.		50 Tons and upwards		
£. s. d.	£. s. d.	£. s. d.	£. s. d.		£. s. d.	Ves.	Tons.	Ves.	Tons.	Ves.	Tons.	Ves.	Tons.	
5,791 18 2	14,016 15 6	19,808 13 8	217,903 19 1	11·0	81,433 4 5	2,070	264,344	164	21,146	62	1,556	289	47,610	Sail. Vess.
								..	..	4	100	10	3,851	Steamers.
12 8 10	55 1 11	67 10 9	..	..	..	39	1,691	..	..	..	..	..	..	Sail. Vess.
..	..	..	..	..	..	10	500	..	..	..	..	..	..	Sail. Vess.
139 0 0	16 14 6	155 14 6	..	..	..	90	6,739	7	386	..	..	..	..	Sail. Vess.
801 0 2	2,571 5 8	3,372 5 10	32,961 0 2	9·8	..	516	24,347	109	11,847	3	127	16	3,704	Sail. Vess.
						47	4,480	..	..	..	..	..	..	Steamers.
138 18 1	400 0 8	538 18 9	10,895 11 3	20·2	..	118	5,981	..	..	..	..	..	..	Sail. Vess.
211 0 0	514 10 0	725 10 0	..	..	1,859 3 0	88	4,145	5	515	36	1,171	82	17,591	Sail. Vess.
						..	..	..	..	..	..	4	308	Steamers.
..	..	50 0 0	..	..	..	24	958	4	301	..	..	..	..	Sail. Vess.
..	..	..	..	..	..	19	1,221	..	..	..	..	..	..	Sail. Vess.
..	..	..	..	..	..	9	357	1	43	..	..	..	..	Sail. Vess.
25 0 0	35 0 0	60 0 0	..	..	..	60	2,800	4	360	..	..	..	..	Sail. Vess.
..	..	490 0 0	1,600 0 0	..	..	37	1,451	4	335	..	..	..	..	Sail. Vess.
..	..	..	..	..	..	1	64	6	431	..	..	..	..	Sail. Vess.
1,478 2 11	1,855 4 7	3,333 7 6	53,984 14 5	16·2	6,572 7 2	679	38,699	52	7,381	20	850	66	6,960	Sail. Vess.
1,417 8 4	407 2 10	1,824 11 2	1,929 7 3	1·1	614 8 9	1,075	55,951	17	3,697	13	469	28	3,932	Sail. Vess.
						273	23,229	..	..	..	..	..	..	Steamers.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	
63 4 5	..	63 4 5	..	..	..	234	7,143	..	..	..	..	..	..	Sail. Vess.
						52	4,524	..	..	..	..	..	..	Steamers.
7 6 9	5 9 7	835 16 4	8,071 6 4	9·6	1,848 17 5	174	10,580	16	981	29	926	82	7,788	Sail. Vess.
† 27 0 0	..	27 0 0	..	..	..	11	462	..	..	..	..	..	..	Sail. Vess.
748 17 5	1,469 17 1	2,218 14 6	12,496 8 10	5·6	..	307	15,851	34	2,214	..	..	..	..	Sail. Vess.
13 12 0	69 0 0	82 12 0	..	..	..	..	☞	..	(g)	..	..	..	..	
64 0 0	..	64 0 0	..	..	..	104	5,036	2	218	..	..	..	..	Sail. Vess.
1 8 0	..	1 8 0	..	..	..	7	355	..	..	..	..	..	..	Sail. Vess.
35 17 0	81 13 0	117 10 0	..	..	..	36	1,918	..	..	..	..	..	..	Sail. Vess.
125 5 0	316 0 0	441 5 0	..	..	..	112	6,045	..	..	..	..	..	..	Sail. Vess.
18 19 7	19 12 2	38 11 9	..	..	..	11	570	..	..	..	..	..	..	Sail. Vess.
..	..	221 0 0	..	..	..	..	☞	..	(g)	..	..	..	..	
30 12 0	10 9 9	41 1 9	..	..	..		☞	..	..	..	..	..	..	
‡ 70 11 1	118 9 0	189 0 1	..	..	..	76	4,500	..	..	..	..	..	..	Sail. Vess.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	
188 16 1	314 13 5	503 9 6	2,381 0 0	6·5	1,856 4 0	696	27,036	22	2,513	44	1,332	47	4,612	Sail. Vess.
						1	12	..	..	..	..	..	..	Steamer.
91 12 3	..	91 12 3	..	..	..	..	(e)	..	..	..	..	..	..	
..	..	15 1 2	..	..	..	18	1,022	8	1,198	..	..	..	..	Sail. Vess.
..	..	..	..	..	..	570	19,890	109	15,398	..	..	..	..	Sail. Vess.
95 11 6	256 14 8	352 6 2	2,465 0 0	7·0	..	347	20,268	151	25,218	..	..	..	..	Sail. Vess.
219 5 4	336 17 9	556 6 1	..	..	..	1,329	66,450	138	17,273	..	..	..	..	Sail. Vess.
..	..	191 0 0	4,034 5 10	21·1	9 10 1	441	12,698	1	157	23	524	3	1,282	Sail. Vess.
						313	38,464	..	..	..	..	2	233	Steamers.
125 17 0	..	125 17 0	..	..	..	126	2,787	..	..	..	..	..	..	Sail. Vess.
						800	83,248	..	..	..	..	..	..	Steamers.
..	..	..	..	..	..	185	8,624	1	135	..	..	..	..	Sail. Vess.
269 4 0	1,014 18 9	1,284 2 9	4,385 0 0	3·4	11,074 14 1	697	16,365	9	1,663	94	2,938	48	5,731	Sail. Vess.
						62	8,005	..	..	..	..	..	..	Steamers.
..	..	3 5 0	..	..	..	695	66,640	3	658	..	..	..	..	Sail. Vess.
* 452 15 0	..	452 15 0	..	..	..	..	..	..	..	..	..	..	..	
14 11 10	..	14 11 10	..	..	..	63	1,721	..	..	..	..	..	..	Sail. Vess.
9 13 7	..	9 13 7	..	..	..	259	8,375	1	253	..	..	..	..	Sail. Vess.
14 14 1	60 1 10	74 15 11	..	..	..	98	1,647	6	1,205	..	..	..	..	Sail. Vess.
						31	4,068	..	..	..	..	..	..	Steamers.
17 9 4	..	17 9 4	..	..	..	70	2,096	..	..	..	..	..	..	Sail. Vess.
..	..	..	..	..	..	293	20,270	..	..	..	..	..	..	Sail. Vess.
41 0 0	91 12 10	132 12 10	545 0 0	4·1	..	143	5,141	2	598	..	..	..	..	Sail. Vess.
						20	2,900	..	..	..	..	..	..	Steamers.
30 18 5	..	39 18 5	..	..	..	99	2,619	..	..	..	..	..	..	Sail. Vess.
93 6 4	..	93 6 4	..	..	..	307	7,943	3	716	..	..	..	..	Sail. Vess.
						64	12,330	..	..	..	..	..	..	Steamers.
67 16 0	89 10 5	157 6 5	..	..	..	116	4,413	..	..	..	..	..	..	Sail. Vess.
..	..	95 0 0	..	..	..	88	2,408	..	..	..	..	..	..	Sail. Vess.
..	..	109 0 0	..	..	..	154	4,501	1	193	46	1,539	22	2,044	Sail. Vess.
						32	6,824	..	..	..	..	1	146	Steamers.

(c) The harbour dues in 1844-5 were let for 661*l.* annually, and in 1846 for 523*l.* (*d*) The arrivals are exclusive of fishing boats.

(e) The arrivals at Bridgeness were, 243 vessels of 14,431 tons.

(*f*) In addition to the arrivals, the Stirling and Granton steamers land and embark passengers at the quay twice a-day.

(*g*) The return for Banff, of arrivals from British Colonies and Foreign, includes those of Gardenstone and Macduff.

(*h*) In addition to the arrivals, a steamer makes 100 voyages annually from Ayr to Campbelltown.

(*i*) No Return furnished from this harbour.

Table showing the aggregate Charges levied on Shipping and on Goods respectively, for the Years 1844-5-6

Port, Harbour, &c.	1844				1845				
	Amount of Dues levied.			Debt due 31st Dec.	Amount of Dues levied.			Debt due 31st Dec.	Gross Receipts of Customs Duty.
	On Shipping.	On Goods.	Total.		On Shipping.	On Goods.	Total.		
	£. s. d.	£. s. d.	£. s. d.	£.	£. s. d.	£. s. d.	£. s. d.	£.	£. s. d.
DUNDEE §	7,486 0 0	15,684 0 0	23,170 0 0	229,090	8,105 0 0	17,214 0 0	25,319 0 0	224,150	46,291 2 1
Balmerino	3 15 1	8 1 0	11 16 1	..	4 1 0	9 18 6	13 19 6	..	..
Ferry Port on Craig	12 18 4	41 10 8	54 9 0	..	13 7 0	38 5 9	51 12 9	..	..
Kingoodie ‡	..	..	30 0 0	..	..	..	30 0 0	..	..
Newport* (*l*)	..	..	7 2 4	..	..	..	5 12 4	..	..
Woodhaven	3 19 1	7 19 5	11 18 6	..	1 16 2	4 10 9	6 6 11	..	..
GLASGOW (*k*)	6,898 6 6	33,262 14 5	40,161 0 11	319,397	7,225 14 6	37,486 4 2	44,711 18 8	320,006	589,527 15 0
Port Dundas	939 2 5	969 11 5	1,908 13 10	..	1,067 17 9	1,147 13 9	2,215 11 6	..	..
Renfrew	..	74 14 2	74 14 2	..	..	82 13 4	82 13 4	..	..
Bowling Bay (*k*)	..	..	..	..	..	..	..	..	..
Paisley † (*m*)	..	411 0 0	411 0 0	47,645	..	402 0 0	402 0 0	47,645	..
GRANGEMOUTH (*f*)	645 8 6	359 12 11	1,005 1 5	..	683 7 4	394 1 5	1,077 8 9	..	16,052 17 10
Pollok's Wharf	3 6 6	1 7 2	4 13 8	..	7 8 6	3 14 7	11 3 1	..	..
GREENOCK	10,492 0 4	2,409 19 2	12,901 19 6	63,752	12,345 14 10	3,091 6 9	15,437 1 7	57,604	288,415 3 10
Ardrishaig |||	298 8 11	20 14 1	319 3 0	1,521	229 6 0	22 19 9	252 5 9	1,591	..
Crinan |||	47 8 4	1 14 5	49 2 9	..	52 18 8	2 13 10	55 12 6	..	..
Gourock (*d*)	531 5 11	33 19 5	565 5 4	2,000	352 8 7	36 15 7	389 4 2	2,000	..
Inverary	49 16 6	21 0 0	70 16 6	..	51 15 0	19 10 0	71 5 0	..	..
Kilmory quay, Loch Gilphead	10 3 0	..	10 3 0	..	10 0 0	..	10 0 0	..	..
Millport*	..	..	75 0 10	..	..	..	80 15 6	..	..
Oban	22 3 4	..	22 3 4	..	22 1 11	..	22 1 11	..	..
Rothesay	574 0 2	..	574 0 2	1,881	621 5 7	12 2 6	633 8 1	1,471	..
Tobermory	13 19 4	3 4 11	17 4 3	..	14 14 3	2 18 2	17 12 5	..	..
INVERNESS (*f*)	48 8 9	821 11 3	870 0 0	..	73 11 11	771 8 1	845 0 0	..	5,359 17 11
Burghead §	118 4 3	269 4 11	387 9 2	22,464	125 15 2	285 16 2	411 11 4	23,369	..
Cromarty	25 0 0	55 0 0	80 0 0	..	20 0 0	70 0 0	90 0 0	..	..
Findhorn ‡ (*d*)	..	..	505 0 0	..	..	..	511 0 0	..	..
Fort William (*f*)	Nil.	Nil.	Nil.	..	..	..	..	..	..
Nairn ‡ (*f*) (*i*)	..	..	103 0 0	..	..	..	97 0 0	..	..
Portmaholmack ||	36 4 10	23 12 9	59 17 7	..	42 13 6	24 3 9	66 17 3	..	..
Stotfield and Lossiemouth § (*f*)	136 17 0	730 0 0	866 17 0	10,240	181 12 0	921 0 0	1,102 12 0	7,000	..
Dingwall	39 3 4	93 15 0	132 18 4	..	55 0 0	106 5 10	161 5 10	..	..
IRVINE	390 17 4	..	390 17 4	634	375 3 3	..	375 3 3	1,072	1,163 2 9
Ardrossan (*f*)	407 1 4	522 10 9	929 12 1	..	721 9 3	927 9 3	1,648 18 6	..	..
Largs	169 11 0	111 16 10	281 7 10	..	199 0 8	130 19 10	330 0 6	..	..
Saltcoats	138 13 1	67 0 5	205 13 6	5,292	116 5 1	52 8 3	188 13 4	5,292	..
Troon § (*e*)	2,029 0 0	2,458 0 0	4,487 0 0	..	1,854 0 0	2,469 0 0	4,323 0 0	..	..
KIRKCALDY	537 4 5	1,162 12 11	1,699 17 4	8,197	526 19 9	1,175 8 1	1,702 8 7	8,963	2,733 19 8
Aberdour	50 4 9	77 18 11	128 3 8	..	47 11 8	73 1 10	120 13 6	..	..
Anstruther ‡	..	..	173 0 0	..	..	..	140 0 0	..	..
Buckhaven	Nil.	Nil.	Nil.	..	..	..	..	..	..
Methil §	34 3 6	80 8 6	114 12 0	..	45 13 3	52 13 5	98 6 8	..	..
Wemyss ¶	113 16 6	2 7 6	116 4 0	..	91 2 0	4 6 11	95 8 11	..	..
Burntisland (*g*)	56 3 9	99 10 0	155 13 9	500	67 19 0	390 3 0	458 2 0	500	..
Crail ‡ (*f*)	8 1 4	..	83 1 4	..	6 8 8	..	73 8 8	..	..
Dysart	182 6 0	162 1 0	344 7 0	..	133 16 0	99 15 0	233 11 0	..	..
Elie (*f*)	11 11 8	28 7 6	37 19 2	..	12 16 6	25 10 6	38 9 0	..	..
Kilrenny or Cellardyke	..	21 0 0	21 0 0	..	..	19 5 0	19 5 0	..	..
Kinghorn } Pettycur } [a]	..	..	180 0 0	..	..	..	180 0 0	..	..
Leven §	90 0 0	178 0 0	268 0 0	..	104 0 0	182 0 0	286 0 0	..	..
Largo* (*h*)	..	..	37 0 0	..	..	..	37 0 0	..	..
Pittenweem	7 7 4	22 13 0	30 0 4	..	7 17 2	31 7 8	39 4 10	..	..
St. Andrew's (*f*)	49 12 5	110 19 7	160 12 0	..	53 1 3	154 6 8	207 7 11	..	..

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[a] The Return does not distinguish dues levied on shipping from those on goods.

† Cash in hand to meet outlay for new harbour, 38,687*l*.

‡ Dues leased out. The charge on shipping at Crail is for local light dues.

§ The charge on shipping includes pilotage.

|| The arrivals are exclusive of 26 boats.

||| The arrivals at Ardrishaig and Crinan are exclusive of 1448 vessels of 35,552 tons, passing through the canal, paying 2526*l*., as canal dues, for the year 1845.

¶ The charge on shipping is for pilotage only.

☞ Return defective.

(*a*) The arrivals include 100 vessels taking shelter.

Debt due on the 31st Dec. of those respective Years; the gross Receipts of Customs Duty, &c.—continued.

1846														
Amount of Dues levied.			Debt due 31st Dec.	Proportion of Debt to Income.	Gross Receipts of Customs Duty.	Number and Tonnage of Arrivals, whether Loaded or In Ballast (Coastwise, British Colonies, and Foreign), and of Vessels Registered at the Port.								Description of Vessel.
						Arrivals.				Vessels Registered at the Port.				
On Shipping.	On Goods.	Total.				Coastwise.		Brit. Colonies and Foreign.*		Under 50 Tons.		50 Tons and upwards.		
£. s. d.	£. s. d.	£. s. d.	£. s. d.		£. s. d.	Ves.	Tons.	Ves.	Tons.	Ves.	Tons.	Ves.	Tons.	
,793 0 0	17,195 0 0	24,988 0 0	221,234 0 0	8·8	57,028 15 1	3,624	192,826	408	63,894	44	1,538	269	45,765	Sail Vess.
						998	121,220	1	405	1	23	6	1,415	Steamers.
2 10 5	5 5 5	7 15 10	..	..	..	..	☞	..	..	..	..	..	..	
14 0 0	39 6 6	53 6 6	..	..	..	153	7,433	6	688	..	..	..	..	Sail. Vess.
..	..	30 0 0	..	..	..	..	☞	..	..	..	..	..	..	
..	..	5 2 4	..	..	..	..	(l)	..	..	..	..	..	..	
1 15 1	5 3 2	6 18 3	..	..	..	..	☞	..	..	..	..	..	..	
,136 15 1	41,034 10 11	49,171 6 0	383,800 0 0	7·8	634,305 14 8	5,494	258,823	430	83,912	66	2,189	381	121355	Sail. Vess.
						8,395	775,233	..	..	12	468	53	10,591	Steamers.
,377 16 7	1,568 17 4	2,946 13 11	..	..	..	3,056	140,711	88	4,880	..	..	..	..	Sail Vess.
..	96 6 5	96 6 5	..	..	..	226	11,476	..	..	..	..	..	..	Sail. Vess.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	
..	400 0 0	400 0 0	47,645 0 0	..	..	747	23,676	..	..	..	..	..	..	Sail. Vess.
,158 17 4	678 19 7	1,837 16 11	..	..	21,103 18 9	899	68,649	292	37,659	7	291	37	5,533	Sail. Vess.
						..	..	..	..	3	56	..	..	Steamers.
10 18 8	6 6 3	17 4 11	..	..	..	..	..	..	..	..	..	..	..	
,827 13 6	2,858 17 0	13,686 10 6	†115,471 13 9	8·4	324,477 7 9	2,204	113,147	261	91,637	198	5,430	232	35,897	Sail. Vess.
						13,311	1,370,002	1	240	1	39	6	507	Steamers.
231 16 1	37 2 9	268 18 10	1,670 4 8	·2	..	32	535	1	118	..	..	..	..	Sail. Vess.
						494	50,427	..	..	..	..	..	..	Steamers.
59 1 2	2 15 10	61 17 0	..	..	..	..	..	1	235	..	..	..	..	Sail. Vess.
						128	13,854	..	..	..	..	..	..	Steamers.
358 0 3	45 3 6	403 3 9	1,933 6 8	4·8	..	363	5,073	1	174	..	..	..	..	Sail. Vess.
						28	4,372	..	..	..	..	..	..	Steamers.
46 0 0	27 0 0	73 0 0	80 0 0	1·1	..	80	1,600	..	..	..	..	..	..	Sail. Vess.
7 6 0	..	7 6 0	..	..	..	286	42,900	..	..	..	..	..	..	Steamers.
						49	343	..	..	..	..	..	..	Sail. Vess.
..	..	102 1 4	..	..	..	..	☞	..	..	..	..	..	..	
18 7 5	..	18 7 5	..	..	..	174	5,445	1	103	..	..	..	..	Sail. Vess.
						115	12,749	..	..	..	..	..	..	Steamers.
562 18 9	17 13 8	580 12 5	1,656 0 2	2·9	..	234	7,254	..	..	..	..	..	..	Sail. Vess.
						1,927	198,185	..	..	..	..	..	..	Steamers.
15 15 3	0 5 0	16 0 3	..	..	..	194	14,235	3	39	..	..	..	..	Sail. Vess.
						56	9,330	..	..	..	..	..	..	Steamers.
76 2 2	1,103 17 10	1,180 0 0	3,498 11 11	3·0	6,154 10 7	399	44,980	8	1,122	145	3,721	86	7,087	Sail. Vess.
								..	..	1	40	..	..	Steamers.
120 13 2	274 3 0	394 16 2	24,321 14 6	61·6	..	216	11,531	1	46	..	..	..	..	Sail. Vess.
						124	10,900	..	..	..	..	..	..	Steamers.
20 0 0	45 0 0	65 0 0	1,100 0 0	16·9	..	114	7,252	1	149	..	..	..	..	Sail. Vess.
..	..	625 0 0	..	..	..	210	13,000	4	600	..	..	..	..	Sail. Vess.
..	..	..	..	..	..	143	5,714	..	..	..	..	..	..	Sail. Vess.
..	..	105 0 0	..	..	..	69	4,434	2	122	..	..	..	..	Sail. Vess.
25 13 6	27 0 8	52 14 2	..	..	..	62	3,442	..	..	..	..	..	..	Sail. Vess.‖
149 8 0	756 0 0	905 8 0	8,000 0 0	8·8	..	82	5,527	4	217	..	..	..	..	Sail. Vess.
51 5 0	96 1 8	147 6 8	..	..	..	..	☞	..	..	..	..	..	..	
355 9 3	..	355 9 3	1,714 11 0	4·8	3,148 1 9	590	30,694	4	1,108	38	1,041	80	14,854	Sail. Vess.
						..	..	..	..	..	..	2	342	Steamers.
564 5 3	724 19 6	1,289 4 9	..	..	..	232	58,774	14	3,431	..	..	..	..	Sail. Vess.
								..	..	..	..	..	..	Steamers.
193 0 0	114 0 0	307 0 0	..	..	..	187	3,071	..	..	..	..	..	..	Sail. Vess.
						1,395	111,734	..	..	..	..	..	..	Steamers.
112 7 3	53 18 2	166 5 5	5,370 3 9	32·3	..	118	7,487	1	176	..	..	..	..	Sail. Vess.
,686 0 0	2,317 0 0	4,003 0 0	..	..	..	1,287	91,353	22	6,648	..	..	..	..	Sail. Vess.
160 6 6	1,485 2 7	2,095 9 1	8,956 13 10	4·3	9,097 10 7	570	22,295	76	10,969	35	1,212	43	8,370	Sail. Vess.
						..	..	..	..	..	..	2	145	Steamers.
43 19 7	66 4 7	110 4 2	..	..	..	..	☞	..	..	..	..	..	..	
..	..	179 0 0	100 0 0	0·6	..	195	9,334	7	385	43	1,422	17	1,619	Sail. Vess.
						..	..	..	..	..	..	1	57	Steamer.
..	..	..	..	..	..	17	658	6	572	..	..	..	..	Sail. Vess.
52 10 11	54 11 4	107 2 3	..	..	..	184	8,442	6	957	..	..	..	..	Sail. Vess.
98 9 6	3 7 5	101 16 11	..	..	..	525	37,471	11	1,139	..	..	..	..	Sail. Vess.
54 12 11	420 11 0	475 3 11	500 0 0	1·0	..	353	12,786	8	762	..	..	..	..	Sail. Vess.
						4	566	..	..	..	..	..	..	Steamers.
10 11 4	..	78 16 4	..	..	..	64	2,197	1	122	..	..	..	..	Sail. Vess.
129 2 0	119 17 0	248 19 0	..	..	..	139	3,682	13	1,403	..	..	..	..	Sail. Vess.
						900	63,000	..	..	..	..	..	..	Steamers.
8 10 9	28 5 0	36 15 9	..	..	..	84	3,376	2	105	..	..	..	..	Sail. Vess.
						1	57	..	..	..	..	..	..	Steamer.
..	20 0 0	20 0 0	..	..	..	Nil.	Nil.	..	..	..	..	..	..	
..	..	180 0 0	..	..	..	120	5,670	6	766	..	..	..	..	Sail. Vess.
122 0 0	191 0 0	313 0 0	..	..	..	223	8,506	11	1,178	..	..	..	..	Sail. Vess.
..	..	40 0 0	..	..	..	..	☞ (h)	..	..	..	..	..	..	Sail. Vess.
7 10 1	35 4 7	42 14 8	..	..	..	37	1,337	1	26	..	..	..	..	Sail. Vess.
46 4 2	134 2 1	180 6 3	..	..	..	264	10,485	6	386	..	..	..	..	Sail. Vess.

d) The arrivals are exclusive of 68 steamers.

e) The arrivals are exclusive of 30 steamers.

(f) Arrivals (coastwise) in cargo only. [See *Note*, p. 659.]

g) In addition to the arrivals, three ferry steamers, of 100 tons, respectively n together 10 trips daily to Granton, and two sailing boats, of 36 tons, each voyage daily to Leith.

(h) The return states that 60 vessels arrived (coastwise) at Largo in 1846.

(i) The arrivals at Nairn include those at Fort George.

(k) Glasgow includes Bowling Bay.

(l) The Return states that 34 vessels arrived (coastwise) at Newport in 1846.

(m) The Return of the number and tonnage of arrivals is for 1844, the latest registered.

Table showing the aggregate Charges levied on Shipping and on Goods respectively, for the Years 1844-5

Port, Harbour, &c.	1844				1845				
	Amount of Dues levied.			Debt due 31st Dec.	Amount of Dues levied.			Debt due 31st Dec.	Gross Receipts of Customs Duty
	On Shipping.	On Goods.	Total.		On Shipping.	On Goods.	Total.		
	£. s. d	£. s. d.	£. s. d.	£.	£. s. d	£. s. d.	£. s. d	£.	£. s.
Kirkwall (*a*)	40 0 0	120 0 0	160 0 0	880	38 0 0	130 0 0	168 0 0	779	1,041 15
Stromness (*a*)	4 10 0	..	4 10 0	..	5 0 0	..	5 0 0	..	..
Sanday (*a*)	Nil.	Nil.	Nil.	..	..	..	..	..	..
Leith (*b*)	12,596 0 0	8,360 0 0	20,956 0 0	228,374	13,611 0 0	9,075 0 0	22,686 0 0	228,374	520,123 5
Cockenzie*	26 5 9	12 13 0	38 19 3	..	58 14 9	76 18 0	135 12 9	..	..
Dunbar (*a*)	86 0 0	275 0 0	361 0 0	5,555	89 10 0	272 0 0	361 10 0	5,832	..
Eyemouth (*c*)	123 10 2	172 7 7	295 17 9	2,473	205 17 8	348 15 6	554 13 2	2,200	..
Fisherrow*	204 4 6	199 6 3	403 10 9	7,185	253 17 4	302 10 2	556 7 6	7,218	..
Granton (*d*)	1,337 7 3	1,832 16 6	3,170 3 9	..	1,465 18 6	2,080 18 1	3,546 16 7	..	..
Morrison's Haven	3 4 6	31 9 11	34 14 5	..	9 5 2	30 5 7	39 10 9	..	..
North Berwick † (*a*)	..	..	56 1 6	..	..	..	107 7 11	..	..
Lerwick (a)	Nil.	Nil.	Nil.	..	..	..	..	..	405 15
Montrose*	1,698 10 2	2,270 17 10	3,969 8 0	45,350	1,905 6 11	2,442 4 1	4,347 11 0	45,650	25,633 4
Gourdon*	92 2 6	103 8 2	195 10 2	..	127 7 10	129 7 8	256 15 6	..	..
Johnshaven*	93 9 6	29 19 2	122 8 8	..	113 6 1	39 6 10	152 12 11	..	..
Perth (*a*)	705 18 9	2,924 4 7	3,630 3 4	43,580	825 4 7	3,519 17 10	4,345 2 5	43,070	12,350 19
Newburgh (*a*)	13 0 0	39 0 0	52 0 0	..	13 0 0	39 0 0	52 0 0	..	..
Newburgh, West (*a*)	25 0 0	53 0 0	78 0 0	..	24 0 0	53 0 0	77 0 6	..	..
Port Glasgow	2,112 7 10	175 6 11	2,287 14 9	38,019	3,443 15 0	266 11 7	3,710 6 7	38,000	106,377 10
Dumbarton	120 0 0	36 0 0	156 0 0	..	127 0 0	40 0 0	167 0 0	..	..
Stornoway	12 1 0	2 4 10	14 5 10	..	25 3 9	3 16 2	28 19 11	..	413 0
Stranraer §	5 0 0	10 0 0	155 0 0	3,424	6 0 0	20 10 10	179 10 10	3,424	134 3
Drumore (*a*)	9 10 0	47 15 0	57 5 0	..	11 10 0	54 19 7	66 9 7	..	..
Port Logan	13 7 8	29 0 10	42 8 6	..	14 14 0	27 10 0	42 4 0	..	..
Port Patrick (*a*)	0 4 4	6 16 5	7 0 9	..	0 14 9	5 13 2	6 7 11	..	..
Wick* †	857 7 2	724 14 8	1,582 1 10	6,156	828 1 8	701 4 6	1,529 6 2	5,227	1,310 19
Castle Hill, by Thurso	Nil	Nil.	Nil.	..	..	..	..	..	..
Helmsdale*	192 0 0	91 2 0	283 2 0	..	142 11 0	67 10 0	230 1 0	..	..
Little Ferry	32 10 0	14 6 0	46 16 0	..	17 0 0	50 6 0	67 12 0	..	..
Lybster	70 2 0	62 19 2	133 1 2	..	77 5 2	88 7 0	165 12 2	..	..
Thurso	16 4 11	..	16 4 11	..	17 10 4	..	17 10 4	..	..
Scrabster	Nil.	Nil.	Nil.	..	..	..	..	..	..
Computed amount of Dues levied on Shipping and Goods not distinguished under their separate heads.	1,174 7 6	1,859 17 8	..	..	1,188 2 0	1,865 18 1	..	..	..
Total Scotland	64,802 7 0	101,904 9 5	166,706 16 5	1,385,915	72,949 10 2	112,858 9 11	185,808 0 1	1,389,326	‡1,711,794 16
Berwick-on-Tweed	969 0 0	2,055 0 0	3,024 0 0	12,700	1,128 0 0	2,229 0 0	3,357 0 0	12,025	12,716 13

* The charge on shipping includes pilotage.

† The Return does not distinguish dues levied on shipping from those on goods.

‡ The net receipts of the Custom Dues for Scotland, for the years 1845–6, amounted to 1,474,673*l*., and 1,711,831*l*., respectively.

§ The greater portion of the Dues on shipping and goods cannot be distinguished.

(*a*) Arrivals (coastwise) in cargo only. For Perth, this refers only to sailing vessels. [See *Note*.]

(*b*) The dues on goods include 1100*l*. a-year on an average, levied by Leith Trinity Corporation.

(c) Dues leased out.

(d) At Granton the dues on goods do not include those on exports.

Debt due on the 31*st* *Dec. of those respective Years; the gross Receipts of Customs Duty, &c.*—continued.

1846

Amount of Dues levied.			Debt due 31st Dec.	Proportion of Debt to Income.	Gross Receipts of Customs Duty.	Number and Tonnage of Arrivals, whether Loaded or in Ballast (Coastwise, British Colonies, and Foreign), and of Vessels Registered at the Port.								Description of Vessel.
On Shipping.	On Goods.	Total.				Arrivals.				Vessels Registered at the Port.				
						Coastwise.		Brit. Colonies and Foreign.		Under 50 Tons.		50 Tons and upwards		
£. s. d.	£. s. d	£. s. d	£. s. d		£. s. d.	Ves.	Tons.	Ves.	Tons.	Ves.	Tons.	Ves.	Tons	
41 0 0	127 0 0	168 0 0	709 19 7	4·2	961 17 10	138	15,913	6	450	28	645	35	4,117	Sail. Vess.
						1	278	..	..	..	..	..	..	Steamer.
5 12 6	..	5 12 6	..	..	..	46	2,858	4	357	..	..	..	..	Sail. Vess.
..	..	..	..	..	..	1	52	..	..	..	..	..	..	Sail. Vess.
482 0 0	10,984 0 0	26,466 0 0	228,374 9 8	8·6	578,590 5 8	3,774	211,713	863	100,572	84	2,392	113	18,422	Sail. Vess.
						672	75,119	..	..	9	200	7	2,012	Steamers.
32 13 6	17 14 7	50 8 1	..	..	..	90	7,457	54	5,354	..	..	..	..	Sail. Vess.
107 10 0	318 0 0	425 10 0	6,151 3 9	14·2	..	239	10,167	22	1,456	14	515	9	775	Sail. Vess.
136 11 2	177 5 3	313 10 5	2,000 0 0	6·4	..	273	10,964	30	2,047	..	..	..	..	Sail. Vess.
						2	56	..	..	..	..	..	..	Steamers.
385 9 1	427 0 10	812 9 11	7,073 1 8	8·7	..	418	17,095	39	2,932	..	..	..	..	Sail. Vess.
,401 12 10	1,956 17 3	3,358 10 1	..	..	..	789	199,456	..	..	..	..	..	..	Sail. Vess.
								..	..	..	..	..	..	Steamers.
15 7 4	47 5 8	62 13 0	..	..	..	46	3,084	7	634	..	..	..	..	Sail. Vess.
..	..	70 15 1	..	..	..	65	1,941	..	..	..	..	..	..	Sail. Vess.
..	..	..	..	..	549 15 3	103	7,014	11	794	64	1,450	8	695	Sail. Vess.
						27	7,506	..	..	..	..	..	..	Steamers.
688 10 5	2,710 17 11	4,399 8 4	45,922 10 4	10·4	26,153 5 8	825	49,101	71	10,911	21	755	95	14,056	Sail. Vess.
						18	2,043	..	..	..	..	2	177	Steamers.
103 8 6	120 8 1	223 16 7	..	..	..	77	3,638	..	..	..	..	..	..	Sail. Vess.
83 15 5	29 0 10	112 16 3	..	..	..	35	1,911	..	..	..	..	..	..	Sail. Vess.
802 12 8	3,703 7 3	4,505 19 11	14,315 8 2	9·8	19,954 6 8	537	32,751	48	4,016	12	349	76	8,358	Sail. Vess.
						808	35,676	..	..	1	13	..	..	Steamers.
13 0 0	39 0 0	52 0 0	..	..	..	96	5,239	18	2,498	..	..	..	..	Sail. Vess.
23 0 0	54 0 0	77 0 0	..	..	..									
,731 14 1	162 0 3	2,943 14 4	36,582 0 0	12·4	135,848 6 8	596	31,943	71	30,141	28	966	34	11,539	Sail. Vess.
						313	12,520	..	..	..	..	5	504	Steamers.
112 0 0	35 0 0	147 0 0	..	..	..	63	2,438	..	..	..	..	..	..	Sail. Vess.
20 0 0	..	20 0 0	..	..	1,009 7 7	81	2,991	12	1,779	42	1,108	15	1,857	Sail. Vess.
						22	2,750	..	..	..	..	..	..	Steamers.
4 0 0	14 15 10	187 15 10	3,424 0 0	18·2	112 0 6	258	18,446	4	1,044	30	929	6	870	Sail. Vess.
						260	28,860	..	..	..	..	..	..	Steamers.
7 0 0	19 0 0	26 0 0	..	..	..	65	2,389	..	..	..	..	..	..	Sail. Vess.
8 0 0	2 6 0	10 6 0	..	..	..	18	457	..	..	..	..	..	..	Sail. Vess.
0 4 7	6 14 0	6 18 7	..	..	..	50	1,084	..	..	..	..	..	..	Sail. Vess.
891 4 3	817 10 0	1,708 14 3	5,828 4 8	12·1	1,232 11 5	440	21,716	109	5,877	17	478	19	1,520	Sail. Vess.
..	..	..	..	..	..	104	4,909	..	..	..	..	..	..	Sail. Vess.
146 12 0	84 19 0	231 11 0	..	..	..	91	4,177	..	..	..	..	..	..	Sail. Vess.
20 7 0	44 6 0	64 13 0	..	..	..	41	2,331	..	..	..	..	..	..	Sail. Vess.
74 11 3	56 7 3	130 18 6	..	..	..	51	2,683	4	267	..	..	..	..	Sail. Vess.
15 19 0	..	15 19 0	..	..	..	116	5,351	3	458	..	..	..	..	Sail. Vess
..	..	..	4,500 0 0	..	..	..	..	..	..	..	..	..	..	
,339 7 10	2,233 2 1	..	..	..	..	..	..	..	..	..	..	..	..	
						46,279	2,710,919	3963	604,832	1291	37,863	2208	443,943	Sail. Vess.(g)
						31,980	3,135,421	2	645	32	945	101	20,289	Steamers.(g)
,360 19 10	120,999 13 9	194,360 13 7	1,566,490 10 8	(f) 8·0	‡1,924,996 3 4	78,259	5,846,340	3965	605,327	1323	38,808	2309	464,232	Totals.
						Vessels. 82,224		Tons. 6,451,867		Vessels. 3,632		Tons. 503,040		
						492	23,971	66	7,771	32	1,027	42	4,496	Sail. Vess.
						179	15,384	..	..	..	..	2	295	Steamers.
,063 0 0	2,159 0 0	3,222 0 0	9,675 0 0	3·0	15,728 14 0	671	39,355	66	7,771	32	1,027	44	4,791	Totals.
						Vessels. 737		Tons. 47,126		Vessels. 76		Tons. 5,818		

(*f*) This is the proportion of the aggregate debt to the whole income of the bours of Scotland; but if the income of those harbours unburdened by a debt excluded, the average proportion of debt to income would be as 9 to 1.

(*g*) In some of the returns the steamers have not been distinguished from the ing vessels, and are included with the latter.

Note.—The instructions forwarded to the harbour authorities, owing to the Dues being leased, or other unavoidable circumstances, could not, in every instance, be complied with; in those cases, however, where the number and tonnage of arrivals have been omitted, or no return has been received, they have been supplied from the table of arrivals and sailings furnished by the Collectors of Customs. (No. 492.)

NB.—For list of harbours where vessels have taken shelter, see p. 661.

No. 492.

*Abstract of the Number and Tonnage of Vessels in Cargo that entered and cleared Coastwise, and of Vessels, both with Cargo and in Ballast, that entered and cleared from and to the British Colonies and Foreign, at the several Ports and Creeks of Scotland, for the Year 1846.**

Port, Harbour, &c.	Arrivals.				Sailings.			
	Coastwise.		British Colonies and Foreign.		Coastwise.		British Colonies and Foreign.	
	Vess.	Tons.	Ves.	Tons.	Vess.	Tons.	Ves.	Tons.
ABERDEEN	1,557	226,903	140	17,960	1,062	170,081	90	17,566
Newburgh	31	2,115	7	386	35	2,582	..	..
Peterhead	257	15,727	81	8,783	195	10,543	101	10,116
Stonehaven	71	3,749	..	..	33	1,493	..	..
ALLOA†	88	4,145	5	515	273	14,572	73	12,708
Cambus	24	958	4	301	..	..	..	..
Clackmannan	19	1,221	..	..	179	8,218	29	3,246
Kennetpans	9	357	1	43	..	..	..	..
Kincardine	5	252	2	170	..	..	..	..
Stirling	37	1,451	4	335	4	119	..	..
Fallin	2	64	6	431	..	..	..	..
ARBROATH	624	33,546	49	6,824	246	12,332	32	4,381
AYR	183	8,644	14	3,595	990	50,298	11	2,216
Girvan	66	2,361	..	..	151	5,790	..	..
BANFF Gardenstone Blackpots Portsoy Whitehills Macduff	201	17,947	16	981	202	12,043	39	2,497
Fraserburgh Pittulie Rosehearty	202	9,447	22	1,013	176	8,326	72	4,857
Port Gordon Cullen Buckie	119	5,782	..	..	37	1,437	..	..
Garmouth	45	2,732	2	218	47	1,920	..	..
BORROWSTOWNESS	85	4,608	22	2,513	207	12,433	16	1,588
Bridgeness	..	..	..	..	151	5,968	2	274
Brucehaven	18	1,022	8	1,198	290	19,13[illegible]	124	15,945
St. David's	..	..	..	..	68	3,979	130	16,435
Inverkeithing	28	1,401	18	2,002	228	9,788	13[illegible]	12,260
CAMPBELTOWN	441	12,698	1	157	92	2,071	..	..
Islay	185	8,624	1	135	96	5,003	..	..
Tarbert	21	564	..	..	4	123	..	..
DUMFRIES	636	18,853	4	887	200	10,236	4	816
Annan	695	66,640	3	658	69	12,705	2	478
Barlochan	171	5,565	1	253	113	3,998	..	..
Carsethorn	123	5,517	6	1,205	55	4,354	..	..
Creetown	60	2,35[illegible]	..	..	22	682	..	..
Garlieston	101	6,689	2	598	76	6,498	1	299
Gatehouse	99	2,61[illegible]	..	..	59	2,061	..	..
Kirkcudbright	286	17,98[illegible]	2	463	135	12,832	3	716
Port William	69	2,74[illegible]	..	..	90	3,108	..	..
Whithorn	88	2,40[illegible]	..	..	85	2,482	..	..
Wigtown	161	10,698	1	193	109	5,894	..	..
DUNDEE	2,296	185,271	367	58,229	1,150	100,295	273	43,520
Ferry-Port-on-Craig District	70	3,502	3	230	26	1,318	..	..
GLASGOW	3,169	379,400	430	83,812	5,059	474,857	811	142,572
Renfrew	46	2,644	..	..	60	4,791	..	..
Bowling Bay	126	20,649	..	..	53	2,398	..	..
GRANGEMOUTH	899	68,649	292	37,659	717	51,275	498	51,381
GREENOCK	434	54,149	248	88,437	57	4,977	190	78,536
Ardrishaig Crinan Kilmory quay, Loch Gilphead Inveraray	136	4,171	2	273	34	1,301	..	..
Oban	289	18,194	1	103	97	3,360	..	..
Rothesay	31	1,249	..	..	16	984	..	..
Tobermory	194	14,235	2	245	229	15,303	..	..
INVERNESS	399	44,980	8	1,122	354	35,777	3	640
Burghead	67	5,001	..	..	52	3,667	6	565
INVERNESS—*continued.*								
Cromarty Dingwall	108	7,044	1	149	154	9,553	..	..
Findhorn	81	6,085	1	239	102	6,842	..	..
Fort William	143	5,714	..	..	14	732	..	..
Nairn, Fort George	69	4,434	2	122	11	918	..	..
Portmaholmack	58	3,287	..	..	73	4,379	..	..
Stotfield and Lossiemouth	82	3,527	4	217	31	1,524	4	35[illegible]
IRVINE	106	5,529	2	321	542	28,178	3	[illegible]
Ardrossan	232	58,774	14	3,431	623	99,762	39	7,4[illegible]
Largs	39	1,422	..	..	5	126	..	..
Saltcoats	7	240	1	176	96	6,210	..	..
Troon	44	3,932	18	5,321	1,064	71,876	63	14,9[illegible]
KIRKCALDY‡	148	8,635	76	10,969	81	5,269	34	5,517
Aberdour	228	10,610	..	..	241	10,493	133	9,12[illegible]
Anstruther			6	329			7	33[illegible]
Pittenweem			..	..			..	..
Buckhaven	84	3,603	6	572	518	23,398	1	131
Wemyss			10	757			17	1,5[illegible]
Dysart			3	454			6	3[illegible]
Burntisland	95	4,686	2	142	61	2,743	1	5[illegible]
Pettycur			6	766			5	702
Crail	64	2,197	1	122	73	2,560	..	..
Elie	84	3,376	2	105	61	3,365	..	..
Methill	179	6,814	5	777	223	7,721	10	1,464
Leven			11	1,178			..	..
Largo			..	..			..	..
St. Andrews	264	10,485	6	386	101	3,941	..	..
KIRKWALL	139	16,191	6	450	164	18,287	4	268
Sanday	1	52	..	..	6	269	..	..
Stromness	46	2,858	4	357	28	1,729	..	..
LEITH	2,507	289,348	863	100,552	1,663	241,055	225	35,315
Cockenzie	69	4,158	18	1,226	118	6,226	52	3,9[illegible]
Dunbar	239	10,167	22	1,456	82	3,075	13	371
Eyemouth	152	5,993	12	1,426	89	3,295	4	109
Fisherrow	277	14,240	44	3,601	30	1,177	..	..
North Berwick	65	1,941	..	..	23	773	..	..
LERWICK	130	14,520	11	794	128	14,099	15	1,114
MONTROSE	509	38,421	63	10,183	365	21,335	58	10,410
Johnshaven	26	1,469	..	..	..	..	..	..
Gourdon	33	1,803	..	..	33	1,684	..	..
PERTH	557	32,751	48	4,016	484	28,751	15	1,37[illegible]
Newburgh	96	5,239	18	2,498	100	4,751	..	..
PORT GLASGOW	59	7,366	71	30,141	15	1,720	57	29,4[illegible]
Dumbarton	40	2,533	..	..	7	607	..	..
STORNOWAY	103	5,741	10	931	95	5,446	10	8[illegible]
STRANRAER	258	18,446	4	1,044	198	16,728	2	562
Drumore	65	2,389	..	..	83	3,298	..	..
Portpatrick	50	1,084	..	..	17	437	..	..
WICK	381	23,313	109	5,877	434	25,776	157	8,646
Helmsdale	106	4,050	2	199	72	2,197	18	1,21[illegible]
Thurso	71	3,301	3	458	143	6,889	3	43[illegible]
Add†	..	..	8	724	..	..	5	1,28[illegible]
Deduct‡	..	..	..	..	..	..	17	1,74[illegible]
Sailing Vessels §	19,911	1,251,506	3290	514,293	19,626	1,143,053	3585	561,1[illegible]
Steamers §	3,277	718,826	..	..	2,528	684,546	..	..
	23,188	1,970,332	3290	514,293	22,154	1,827,599	3585	561,1[illegible]
Totals	Vess. 26,478		Tons. 2,484,625		Vess. 25,739		Tons. 2,388,7[illegible]	
	Vess. 52,217				Tons. 4,873,374			

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* This table does not include arrivals of vessels which broke bulk, and sailings which took in cargo previously at another port; or vessels merely seeking shelter.

† The arrivals in ballast at Alloa and Creeks (British Colonies and Foreign) were *in cumulo*, 8 vessels of 724 tons; the sailings 5 of 1,285 tons; they are not included in the Return.

‡ The Return for Kirkcaldy and Creeks includes 17 vessels, of 1742 tons, (British Colonies and Foreign,) outwards, previously cleared at other ports.

§ These totals, distinguishing the sailing vessels from steamers, are obtained from No. 258 (Parl. Paper, 1847).

No. 493.
Number and Tonnage of Vessels taking shelter at Scottish Ports, 1846.

No. 493.

From several of the Harbours there are returns of the Number and Tonnage of Vessels taking shelter in 1846, which are as follows:—

Name of Port, Harbour, &c.	Vessels.	Tons.	Name of Port, Harbour, &c.	Vessels.	Tons	Name of Port, Harbour, &c.	Vessels.	Tons.
ABERDEEN	151	10,348	DUMFRIES.			KIRKALDY—*cont.*		
Peterhead	118	5,642	Balcary Bay Cibbshole	133	..	Pittenweem	40	..
Stonehaven	16	794				St. Andrews	15	382
			Garlieston	20	1,200	KIRKWALL.		
ALLOA	7	2,829	Port William	22	846	Stromness	397	..
			GREENOCK	45	1,674	Other Creeks	183	..
ARBROATH	17	..	Gourock	100	..			
AYR	15	928	Tobermory	800	..	LERWICK	176	..
BANFF.			INVERNESS.	176	..	LEITH	2	113
Fraserburgh	153	8,187	Burghead	26	952	Eyemouth	101	4,561
Cullen	5	120	Cromarty	616	..			
Portsoy	9	405	Portmaholmack	10	..	MONTROSE.	56	2,965
			Stotfield, &c.	13	273	STORNOWAY	221	..
BERWICK-ON-TWEED	50	2,568	IRVINE.			STRANRAER	24	1,755
BORROWSTOWNESS.			Troon	47	3,523	Port Logan	25	870
Inverkeithing	42	4,100	KIRKCALDY.			WICK	15	821
CAMPBELLTOWN	502	..	Dysart	4	130	Helmsdale	1	29

No. 494.

Table showing the number of Boats, whether Decked or Undecked, that were employed in the Shore-curing Herring and Cod and Ling Fisheries, and the number of the Fishermen and Boys by whom the said Boats were manned, at the several Fishing Districts in Scotland, and in most cases at their respective Creeks, in the year ending 5th January, 1847.—[Vide British Fishery Report, 1846.]

Name of District and Creek.	Number of Boats employed at the		Number of Men and Boys by whom the Boats were manned at the	
	District.	Several Creeks.	District.	Several Creeks.
ANSTRUTHER	393	..	1975	..
Ferry Port-on-Craig	..	3	..	15
St. Andrews	..	13	..	65
Kingsbarns	..	3	..	15
Crail	..	8	..	40
Cellardyke	..	102	..	510
Anstruther	..	4	..	20
Pittenweem	..	47	..	235
St. Monance	..	85	..	425
Elie	..	3	..	15
Leven	..	2	..	10
Buckhaven	..	125	..	625
BANFF	93	..	401	..
Portsoy	..	12	..	52
Whitehills	..	25	..	107
Banff	..	6	..	25
Macduff	..	18	..	77
Gardenstone	..	18	..	79
Crovie*	..	14	..	81
CAMPBELLTOWN AND ISLAY	588	..	1836	..
Campbelltown	..	130	..	464
Skipness	..	60	..	180
Carradale	..	44	..	130
Torrisdale	..	13	..	31
Southend	..	7	..	28
Saltpans	..	8	..	32
Ballochinten	..	10	..	22
Clachan	..	18	..	38
Tynelosn	..	12	..	24
Glenbar	..	9	..	18
Island of Gigha	..	51	..	140
Portnahaven (Islay)	..	84	..	232
Port Charlotte	..	30	..	90
Loch Grounard	..	21	..	63
Bowmore	..	23	..	69
Port Ellen	..	26	..	144
Portaskaig	..	22	..	88
Island of Colonsay	..	10	..	40
CROMARTY	257	..	1018	..
Avoch	..	48	..	192
Fortrose	..	8	..	40
Cromarty	..	50	..	200
Balculan	..	24	..	96
Shandwick*	..	16	..	64
Ballintore*	..	16	..	64
CROMARTY—*continued.*				
Hilton*	..	32	..	110
Rockfield	..	16	..	64
Portmaholmack	..	27	..	108
Inver*	..	20	..	80
DUMFRIES AND STRANRAER	205	..	633	..
Priestside and Caerlaverock	..	..	..	18
Coast from Carse-thorn to Colvend	..	..	..	30
Kirkcudbright	..	7	..	22
Carleton	..	14	..	32
Whithorn Isle	..	9	..	25
Portwilliam and Monreith	..	23	..	50
Glenluce	..	6	..	22
Sandhead	..	13	..	26
Drumore	..	15	..	45
Port Logan and Clanyard Bay	..	7	..	25
Port Patrick	..	21	..	63
Stewarton and Portmore	..	21	..	62
Stranraer	..	25	..	75
Cairn Ryan	..	8	..	30
Ballantrae	..	28	..	82
Carlton	..	8	..	26
EYEMOUTH	166	..	823	..
Eyemouth	..	48	..	227
Berwick and Greensea	..	34	..	170
Burnmouth and Ross	..	29	..	145
Coldingham	..	20	..	104
Cove	..	7	..	37
Dunbar	..	28	..	140
FINDHORN	285	..	873	..
Lossiemouth	..	56	..	141
Hopeman	..	38	..	114
Burghead	..	31	..	104
Findhorn	..	19	..	73
Nairn	..	76	..	171
Dilness	..	10	..	40
Campbelltown	..	11	..	44
Culloden	..	9	..	36
Clachnaharry	..	11	..	44
Craighton	..	10	..	50
Pettie	..	14	..	56

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* There is no pier at this creek.

Name of District and Creek.	Number of Boats employed at the		Number of Men and Boys by whom the Boats were manned at the	
	District.	Several Creeks.	District.	Several Creeks.
FRASERBURGH	456	..	950	..
Pennan	..	35	..	50
Rosehearty	..	74	..	160
Pittulie	..	45	..	76
Fraserburgh	..	109	..	300
Cairnbulg*	..	66	..	125
Inverallochy*	..	77	..	144
Charleston*	..	4	..	5
St. Comus*.	..	46	..	90
GREENOCK, AYR, &c.	491	..	1170	..
Helensburgh and Dumbarton	..	18	..	42
Gairloch and Roseneath	..	43	..	100
Greenock and Port Glasgow	..	36	..	95
Gunnan to Loch Goil entry	..	20	..	52
Arrochar and vicinity	..	28	..	65
Loch Goil	..	24	..	58
Portinstuck and Ardintinny	..	18	..	45
Holy Loch and vicinity	..	24	..	54
Dunoon and vicinity	..	25	..	56
Gourock	..	18	..	44
Innerkip and Coast to Largs	..	32	..	60
Largs and Fairlie	..	34	..	66
Port-in-Cross	..	12	..	36
Ardrossan	..	15	..	38
Saltcoats	..	18	..	44
Irvine	..	22	..	35
Troon	..	14	..	40
Ayr	..	26	..	58
Dunure	..	20	..	56
Colzean	..	12	..	36
Girvan and Turnberry	..	34	..	90
HELMSDALE†	213	..	760	..
Dunbeath, &c.	..	103	..	320
Berriedale, &c.	..	16	..	64
Helmsdale, &c.	..	40	..	160
Pot Gower	..	17	..	68
Brora	..	11	..	44
Golspie, Embo, &c.	..	26	..	104
INVERARY, LOCH GILPHEAD	1201	..	3529	..
West Coast of Loch Fyne to Tarbert	..	370	..	1110
East Coast of Loch Fyne to Ardlamont	..	220	..	660
West Tarbert to Oban	..	60	..	180
Oban to Fort William	..	130	..	260
Fort William to Loch Eil-head	..	120	..	240
Island of Lismore	..	20	..	40
Loch Sunart, Arasaig, and Moidart	..	100	..	300
Ardnamurchan	..	45	..	135
Tyree and Call	..	26	..	184
Iona and Loch Skridan	..	30	..	120
South Coast of Mull	..	60	..	240
North ditto	..	20	..	80
LEITH AND BURNTISLAND	386	..	1148	..
North and South Queensferry	..	22	..	78
Newhaven	..	180	..	350
Fisherrow	..	68	..	250
Preston Pans	..	40	..	150
Cockenzie	..	35	..	120
Portseaton	..	12	..	84
North Berwick	..	8	..	32
Kirkcaldy	..	9	..	36
Dysart	..	2	..	8
Burntisland	..	8	..	32
Inverkeithing	..	2	..	8
LOCH BROOM, ULLAPOOL	466	..	1659	..
Loch Nedd	..	10	..	36
Drumbeg	..	11	..	41
Gulkeen Drumbag	..	16	..	60
Clacknessie	..	16	..	58
Achnecharn	..	9	..	35
Gulkeen Achnecharn	..	12	..	40
Clashtol	..	23	..	100
Achmelvich	..	20	..	72
Inver Kirkag	..	9	..	31
Reef	..	12	..	44
Island of Tanera	..	9	..	36
Acheldehnc	..	19	..	65
Badenscally	..	11	..	40
Ardmuir and Glutton	..	9	..	36
Moorfield	..	13	..	48
LOCH BROOM, ULLAPOOL—*cont.*				
Ullapool	..	60	..	160
Number of boats and men not distinguished under their several creeks	..	207	..	762
LOCH CARRON AND DUNVEGAN	595	..	2303	..
LOCH SHIELDAIG	183	..	702	..
LYBSTER‡	249	..	1230	..
Latheron Wheel	..	26	..	130
Forse	..	37	..	185
Swiney	..	11	..	55
Lybster	..	107	..	520
Ousnister	..	20	..	100
Clyth	..	30	..	150
East Clyth	..	18	..	90
ORKNEY, NORTH ISLES	261	..	1174	..
North Ronaldshay	..	14	..	63
Sanday	..	19	..	85
Westray and Papa	..	62	..	279
Fero	..	4	..	18
Eday	..	33	..	149
Stronsay	..	51	..	229
Eigelsay	..	4	..	16
Rousay	..	18	..	81
Wire and Girsay	..	4	..	14
Shapinshay	..	52	..	238
ORKNEY, SOUTH ISLES	434	..	1954	..
Swona	..	3	..	12
South Ronaldsha	..	161	..	805
Walls and Hoy	..	36	..	144
Flotta	..	38	..	152
Greamsa	..	2	..	8
Cara and Farra	..	2	..	8
Burra	..	40	..	169
Pomona	..	151	..	661
Copinsha	..	1	..	4
PETERHEAD	234	..	862	..
Burnhaven	..	9	..	36
Boddam	..	69	..	166
Bullers of Buchan	..	5	..	22
Peterhead	..	79	..	374
Ward of Cruden	..	11	..	44
Whinnefold	..	7	..	28
Old Castle	..	2	..	12
Colliestown	..	25	..	70
Aberdeen	..	27	..	108
PORT GORDON	416	..	2101	..
Buckie	..	163	..	815
Port Essie	..	50	..	254
Port Gordon	..	38	..	196
Findochtie	..	38	..	192
Portknockie	..	81	..	410
Cullen	..	30	..	150
Sandens	..	14	..	74
Speymouth	..	2	..	10
ROTHESAY	233	..	832	..
Schoolock Bay	..	6	..	20
Kilchatten Bay	..	7	..	21
Gallachan Bay	..	8	..	24
Rothesay	..	25	..	80
St. Ronald's Bay	..	6	..	22
Port Bannatyne	..	16	..	48
Lamlash, in Arran	..	23	..	96
Brodick "	..	8	..	34
Loch Ranza "	..	12	..	52
Corrie "	..	8	..	35
Blackwater-foot "	..	8	..	35
Cattigoe Bay "	..	8	..	32
Pladda	..	10	..	42
Whiting Bay	..	9	..	36
Milport Cumbraes	..	14	..	42
Number of boats and men not distinguished under their several creeks	..	65	..	211
SHETLAND, LERWICK	524	..	1744	..
Lerwick and Gulberwick	..	39	..	78
Bressay and Noss Islands	..	8	..	38
Lunnasting, Nesting, Whalsey, and Skerries	..	100	..	385
Sandwick and Cuningsberg	..	74	..	378

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* There is no pier at this creek. † There were also employed in the herring fishery 158 boats, belonging to other districts.
‡ In addition to these, 20 strange boats, manned by 100 men, fished in the district during the season.

Name of District and Creek.	Number of Boats employed at the District.	Number of Boats employed at the Several Creeks.	Number of Men and Boys by whom the Boats were manned at the District.	Number of Men and Boys by whom the Boats were manned at the Several Creeks.
SHETLAND, LERWICK—*continued.*				
Dunrossness and Fair Isle	..	143	..	438
Quarff, with Islands of Burra	..	49	..	84
Tingwell. with Papa, Oxena Isles, &c.	..	57	..	164
Whiteness and Weesdale	..	12	..	28
Sandsting and Aithsting	..	42	..	151
SHETLAND, UNST	141	..	743	..
SHETLAND, WALLS	263	..	1440	..
Sandness	..	7	..	36
Springfield	..	10	..	48
Vaila	..	11	..	66
Seafield	..	7	..	38
Papa Island	..	34	..	183
Ollabery	..	39	..	220
Hillswick	..	29	..	155
Stanness	..	9	..	54
North Roe	..	29	..	155
Mossbank	..	23	..	121
Voe Delting	..	9	..	56
Brae	..	20	..	111
Number of boats and men not distributed under their respective creeks	..	36	..	197
STONEHAVEN	298	..	1154	..
Broughty Ferry	..	16	..	64
Easthaven	..	8	..	24
Westhaven	..	8	..	24
Arbroath	..	18	..	60
Auchmithie*	..	37	..	73
Uzon	..	11	..	40
Ferryden	..	44	..	204
Montrose	..	6	..	29
Milton	..	2	..	10
Johnshaven*	..	10	..	40
Gourdon	..	27	..	82
Catterline	..	4	..	16
Crawton	..	5	..	22
Stonehaven	..	10	..	50
Cowie	..	14	..	60
Stranathera	..	8	..	32
Skateraw	..	10	..	42
Downies	..	8	..	38
Portlethen	..	13	..	68
Findon	..	12	..	60
Cove	..	16	..	64
Burnbank	..	3	..	12
Torry	..	8	..	40
STORNOWAY AND BARRA	634	..	3726	..
Polsta, Skegasta, and Calicot	..	65	..	390
Loch Carloway and Sernera	..	20	..	120
Stornoway, Baybla, and Broadbay	..	120	..	720
Loch Roag and neighbourhood	..	45	..	270
Loch Roag to Island of Harris	..	34	..	204
West side of Island of Harris	..	12	..	72
East side " "	..	42	..	220
West side of North Uist	..	53	..	310
East side " "	..	38	..	190
Barra and surrounding islands	..	60	..	360
STORNOWAY AND BARRA—*cont.*				
Loch Boisdale, Loch Eynort, and neighbourhood	..	40	..	240
Harris to Loch Shell	..	21	..	126
Loch Shell to Stornoway	..	84	..	504
THURSO	177	..	553	..
Portskerry†	..	26	..	66
Sandside†	..	9	..	20
Crosskirk†	..	7	..	15
Thurso†	..	17	..	85
Murkle	..	10	..	36
Castlehill	..	2	..	8
Dunnet	..	11		
Brough	..	6	..	70
Ham	..	9		
Scarfskerry	..	15	..	37
Mey	..	26	..	84
Gills	..	10	..	36
Huna	..	18	..	55
Stroma	..	11	..	31
TONGUE	136	..	816	..
Strathyhead	..	4	..	24
Armadale	..	12	..	72
Kirktomie	..	17	..	102
Farr	..	4	..	24
Torrisdale	..	2	..	12
Skerray, including Island Roan	..	10	..	60
Skullamay	..	6	..	36
Coldbacky	..	1	..	6
Talmina	..	10	..	60
Port Vasgo	..	8	..	48
Porthamel, Rispond, and Smoo	..	12	..	72
Eddrachillies, including Kinlochbervie, Loch Inchard, Scoury, and Badcall	..	50	..	300
WICK	552	..	2,649	..
Wick	..	338	..	1640
Ramsgoe	..	4	..	20
Broadhaven	..	6	..	28
Girnigoe	..	5	..	24
Staxigoe	..	38	..	180
Ackergill	..	12	..	56
Keiss	..	46	..	226
Ankingill	..	11	..	50
Freswick	..	26	..	126
Duncansby	..	8	..	34
Whaligoe	..	25	..	116
Sarclat	..	33	..	149
Number of boats and men not distinguished under their several creeks, in Scotland, (exclusive of Loch Broom, Rothesay, and Walls)	..	1127	..	4381
Total Scotland	10,535	10,535	40,758	40,758
Number of boats and men employed at other stations in England and the Isle of Man	4,541		20,466	
Totals	15,076		61,224	

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* There is no pier at this creek.

† The boats belonging to Portskerry, Sandside, Crosskirk, and Thurso, are mostly employed there, but this is not the case with the other creeks in this district.

No. 495.

APPENDIX C.

Supplement.

GLASGOW.

No. 495.
Income and Expenditure, 1844-5, 45-6, 46-7.

Income and Expenditure of the Clyde Trustees for the Years 1844-5, 1845-6, 1846-7.

INCOME.

	1844–5			1845–6			1846-7		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Tonnage dues	37,577	19	4	32,516	1	5	36,364	3	2
Quay dues				7,118	8	0	7,844	9	11
Crane dues				374	8	11	493	0	11
Weighing dues				1,611	6	7	1,655	19	10
Shed dues	5,142	14	4	5,089	12	3	7,378	2	1
Tonnage dues received on lower stages of river	not distinguished			316	9	8	596	18	6
Ferries	1,118	7	6	1,126	4	5	1,372	10	6
Rhones and planks	479	19	6	600	7	8	919	14	7
Water, supplying vessels	392	18	0	418	7	1	546	12	1
Cumbray Lights, received proportion of surplus payable to Clyde Trustees	899	18	3	1,376	13	2	898	17	10
Rents	185	0	0	229	1	2	599	3	9
Police, fines levied	41	14	0	49	14	11	119	4	0
Miscellaneous	31	14	11	371	16	11	298	6	0
Totals . . £	45,870	5	10	51,198	12	2	59,017	2	9

EXPENDITURE.

	£.	s.	d.	£.	s.	d.	£.	s.	d.
COLLECTION AND MANAGEMENT OF THE REVENUE:—									
Salaries	3,300	14	4	3,621	3	5	4,386	14	4
GENERAL EXPENSES:—									
Gas, coal, office stores, sweeping quays, repairs of pipes, quay walls, buoys, perches, painting, &c.	1,135	1	4	2,118	0	11	1,936	16	8
CONTINGENT EXPENSES:—									
Stationery, printing, advertising, bill stamps, subscriptions, &c.	643	10	0	779	5	10	774	0	9
EXTRAORDINARY EXPENSES:—									
Opposition to West of Scotland Junction Railway Bill:—									
Paid to Deputation and witnesses	..			..			174	19	0
Engineers' and surveyors' accounts	..			50	0	0	660	4	0
Parliamentary agents	..			1,000	0	0	318	6	10
Secretary's account for opposition	..			77	16	4	117	11	7
Opposition to Glasgow Junction Railway Bill:—									
Paid to Deputation and witnesses	1,054	0	0	448	5	9	..		
Engineers' and surveyors' accounts				876	18	11	..		
Solicitors' accounts				2,423	16	8	..		
Secretary's account for opposition				240	6	0	..		
Printing evidence				63	4	6	..		
Other Law and Parliamentary expenses	1,604	9	8	828	5	3	982	3	6
Interest on borrowed money	11,146	5	3	12,571	17	6	17,816	15	7
Ground, annuals, and feu duties	1,816	19	0	2,436	19	6	3,157	16	7
Dredging and repairs of machines *	14,023	18	10	6,820	18	2	6,500	18	0
Repairs of quays and wharfs	2,341	0	4	4,019	3	11	2,836	9	11
Repairs of cranes, rhones, planks, sheds, weighing machines, and wages	620	13	3	1,282	9	10	1,379	4	1
Ferries	312	11	6	336	10	1	272	19	5
Light-houses in river	..			183	13	1	171	1	8
Police	1,969	6	9	1,715	0	8	1,529	12	9
Water	549	7	6	445	9	3	427	8	10
Taxes	233	19	7	102	13	4	124	4	1
EXPENDITURE ON NEW WORKS AND IMPROVEMENTS:—									
Expenses for obtaining new Act of Parliament	..			1,119	1	11	2,048	2	10
Engineering and surveying	..			211	15	6	985	12	9
Improving and building quays, court-houses, &c.:—	2,546	14	9	..			..		
Govan Ferry quay	1,150	0	0	236	10	10	..		
Lancefield quay	935	13	8	55	14	1	..		
Springfield quay	..			..			8,251	0	7
Finnieston new quay	..			3,745	8	1	14,927	19	3
Building dykes, beacons, &c.	..			672	13	8	744	0	10
New court-houses	..			421	14	8	74	4	7
Temporary wooden wharf, Springfield	..			..			2,728	7	2
South quay wall	..			..			2,371	18	7
General harbour improvements	..			..			2,083	14	2
Dredging, applicable to improvements of the river.*	..			4,547	5	6	4,333	18	8
New weir at Stockwell-bridge	800	0	0	1,518	16	8	..		
Purchase of grounds, &c.	51	0	0	..			..		
Parkholm ground and machinery	..			22,357	0	0	..		
Alveus of river	..			436	10	0	..		
Stobcross grounds	..			..			63,750	0	0
Ground of General Railway Terminus Company	..			..			45,000	0	0
Mavisbank grounds	..			..			29,734	4	0
Plantation grounds	..			..			29,467	11	0
Lancefield grounds	..			..			565	16	
Addition to premises in Robertson-street	1,228	7	10	..			..		
Expenses of purchase, disposition, jury, trials, &c.	2,560	4	0	3,050	16	9	4,917	10	0
Interest on purchase money of grounds	..			415	5	5	6,054	0	0
Totals . . £	50,113	18	1	61,230	18	0	261,607	5	8

* The dredging applicable to improvements on the river is not distinguished for the year 1844-5.

APPENDIX C.

Supplement.

GLASGOW.

No. 496.

Revenue, Expenditure, and Debt, of the Clyde Trustees.

No. 496.

Continuation of Statement of the Revenue, Expenditure, and Debt of the Clyde Trustees, from the Year 1770 *to June* 1847.

Totals brought forward from Table 357, *p.* 484:	Revenue.	Expenditure.	Surplus.	Deficiency.	Debt.
	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£ s. d.
From 1770 to 1846 .	898,280 17 1¾	1,229,614 2 1¾	55,859 12 1½	403,266 6 2½	347,406 14 1
June, 1847 . . .	59,017 2 9	261,607 5 8	*2,231 8 8	202,590 2 11	547,765 8 4
Totals . . .	957,297 19 10¾	1,491,221 7 9¾	58,091 0 9½	605,856 9 1½	. .
Amount of Debt.	547,765 8 4	. .	. .	. .	. .
Add Receipts not included in the Revenue	10,495 14 4	24.337 14 9	Amount Expended, but not included in the Expenditure.		
Total Expenditure	1,515,559 2 6¾	1,515,559 2 6¾			

* Not included in the Revenue.

CELLARDYKE.

No. 497.

Leslie, on a projected Fishing Harbour.

CELLARDYKE.

No. 497.

Report by JAMES LESLIE, Esq., C.E., *on a Projected Fishing Harbour at Craignoon, Cellardyke.*

Dundee, September, 1838.

AT the request of Mr. W. F. Conolly, acting for the fishermen and others who take an interest in the proposed harbour, I visited Cellardyke on the 9th July last, during a spring-tide, and on that and the following days carefully examined Craignoon, the site that had been pointed out to me as being the most eligible for a harbour, having previously sent an assistant to survey and take levels of the shore and adjacent rocks; and on the accompanying plan and sections I have shown the form of the harbour and the details of the piers which, under the circumstances, I would consider the best adapted for the situation.

The site in question possesses very considerable natural advantages, derived chiefly from the shelter afforded by the high ridge, called the Sandling Rock, which lies immediately outside of it, and in a line parallel with the shore. This rock is in general nearly as high as the level of high water, and has a pretty uniform slope towards the sea of about 4 horizontal to 1 perpendicular; and it extends eastward nearly 700 feet, from a gat-way or natural opening through it, opposite the Tolbooth Wynd, which, opening when widened, would form an outer entrance to the harbour. During easterly winds this ridge of rocks will afford perfect shelter to the space inside till nearly half tide, and when at high water it must have a considerable effect in breaking the force of the sea before it reaches any pier situated between it and the shore. To the westward of the opening above mentioned, the outer ridge of rocks, which extends 450 feet in that direction, is considerably lower, being in no part more than about 8 feet above the level of low water; and it dips towards the west end, so that before half tide it forms a sunken rock or skelly, but it will still be sufficient to break any westerly sea until there be water enough for boats to enter the inner harbour.

The east pier is proposed to be situated on the ridge of rocks inside of the Sandling Rock, and formed so as to overlap the west pier, which will be a continuation of the Tolbrook Wynd, and all the interior of the harbour will require to be excavated out of the rock, as well as a space outside of the harbour mouth, to form the entrance fairway. Immediately inside of the outer ridge of rocks, and between it and the proposed pier, there is a deep pool, wherein boats may float at dead low water of spring-tides. There are a good many boulder stones just now lying in the eastern part of this pool, but they will require to be removed for the purpose of building the piers, which will have the effect of making the bottom fair and level. In consequence of the accommodation afforded by this pool, the interior of the harbour will not require to be excavated to such a depth as would otherwise be necessary, as at or near low water, when boats cannot get into the artificial or inner harbour, they will be effectually sheltered in the natural half-tide harbour outside; and by the time the sea comes to break over the outer rocks, there be will depth sufficient to enter the inner harbour.

About 250 feet to the westward of the opening before mentioned, there is another opening through the outer ridge of rocks; it is narrower than the other, but it is about a foot deeper, and a boat can get through at low water; but at the distance of 200 feet still further west, and at the extreme end of this ridge, there is a clear opening of 300 feet in width, with ample depth, and this probably will form the best entrance to the outer harbour at low water.

The rock on the site of the harbour, and immediately to the west of it, is of very good quality, and well adapted for the purpose of harbour works, being of freestone, easily raised in beds, and generally hard and solid; and I believe that enough may be procured there to serve for the whole of the building. In consequence of the sea being so much broken by the Sandling Rock, the building will not require to be so heavy or expensive as it would otherwise be on this rough coast. I propose to form the back wall of pitching, having a slope of one to one, and terminating in a circular sweep towards the parapet, which will finish with a batter of 2 inches per foot. The parapet is intended to be of the same height as that of the present harbour, but the surface of the pier may be a foot lower. There will be no parapet required for the west pier, and the width of the mouth of the harbour will be sufficient at 50 feet. The interior area of the harbour, allowing room for a road along the inner side, is 1½ acre, or about the same size as the present harbour. The Tolbooth Wynd will form a sufficient access from the street to the west pier; but an opening will require to be formed to the east pier, through the property immediately to the west of Mr. Crawford's.

The situation of Craignoon is very central as regards the town of Cellardyke, and in my opinion a harbour constructed there in the manner before described would afford every accommodation that could be required for the fishing-boats, and the sea being checked and broken by the rocks before reaching the harbour mouth, the shelter inside would be very complete even in the heaviest gales; and as the depth increases very fast outside of the rocks, great facility will be afforded for putting to sea or taking the harbour, even at the lowest tides; and very good accommodation might be easily provided for steam-boats to land and take on board passengers and cattle.

APPENDIX C.

Supplement.

CELLARDYKE

No. 497.
Leslie, on a projected Fishing Harbour.

The cost of construction will, however, notwithstanding the advantages in point of economy before enumerated, be very considerable. After making careful inquiries of persons who have experience in the nature of the rocks and the description of work the sum which I estimate as being necessary to complete the work in a substantial manner, is 5856*l*. In all probability there will be some difficulties to be encountered before such a sum can be procured.

I have no doubt that a harbour could be made at Craignoon much more safe and commodious, and easier of access for fishing-boats, than the present harbour, and also less liable to damage when constructed; but unless there be some reasonable prospect of procuring sufficient funds for the purpose, upon which point I have not the means of judging, it would in my opinion be advisable rather to attempt some improvement in the present harbour, by which the commotion inside during easterly gales might be checked, and the boats enabled to lie in greater safety.

I have been informed that a plan for its improvement has been proposed by Mr. Mitchell; this plan I have not seen, but I think that by narrowing the entrance, which at the instance of the fishermen, as I have been informed, was originally made far too wide, and by extending the eastern pier as far as the point of the rocks, the run in the harbour will be very materially lessened, without making the entrance at all circuitous or difficult to navigate.

In addition to this, the rocks on the side of the harbour next the street might be quarried down, leaving merely a narrow quay for access to the boats; by these means the area of the harbour would be enlarged, and it would both afford greater accommodation for boats, and allow more room for the waves to expand inside, which would in some further degree tend to reduce the swell in the harbour, and make it more tranquil.

JAMES LESLIE.

Estimate of a Harbour proposed to be built at Craignoon, Cellardyke.

	£.	s.	d.
12,332 cubic yards of rock to be excavated, at 2*s.* 6*d.* per yard	1541	10	0
6508-6 cubic feet of cope, at 1*s.* per foot	325	8	6
6535 cubic feet of rough-headed ashlar, for the outside of the west pier, at 8½*d.*	231	8	11½
32,661 cubic feet of smooth-faced ashlar for the inside of the piers, at 9*d.*	1224	15	9
41,500 cubic feet of rubble backing, at 2*d.*	345	16	9½
4466 cubic yards of hearting, at 1*s.* 6*d.* per yard	334	19	0
973 superficial yards of causewaying, at 5*s.* 6*d.*	217	11	6
26,605 cubic feet of pitching, at 8*d.*	886	16	8
787 cubic feet of stair steps, at 1*s.* 4*d.*	52	10	0
57 cubic feet of stair plats, at 1*s.* 3*d.*	3	12	2
128 cubic feet of fenders, at 3*s.* 6*d.*	22	8	0
128 lineal feet of fender rozlets, at 7*d.*	3	14	8
8 fenders caps, at 7*s.* each	2	16	0
15 mooring rings or paul stones, at 2*l.* each	30	0	0
	5223	8	0
Forming an opening to the street from the east pier, and purchase of property, say	100	0	0
	5323	8	0
Contingencies 10 per cent.	532	12	0
	£5856	0	0

No. 498.
Estimate of deepening the Clyde.

GLASGOW.

No. 498.

Estimate of Deepening the River Clyde, commencing 1770 *and ending* 1845, *including the Expense of the construction of the Jetties, River Dykes, Beacons, Lights, and Bowling Basin.*

	£	s.	d.	£.	s.	d.
Works constructed under Mr. Golborne, consisting of jetties, and deepening Dumbuck Ford, &c.	9,060	7	6			
Works executed under Mr. Rennie, consisting of 35,200 lineal yards of river dykes from harbour to Bowling, at 25*s.*	44,000	0	0			
7920 lineal yards of river dykes from Bowling to Dumbarton, at 20*s.*	7,920	0	0			
Amount for constructing jetties, as recommended by Mr. Golborne and Mr. Rennie	..			60,980	7	6

Amount of Excavation, commencing Sept. 1824 to 1845, performed by Steam-dredging Machines:—

	Average. Punt Loads.	Years.	Punt Loads.
No. 1. Dredge	3,355 ×	13 =	43,615
2. Ditto	3,690 ×	11 =	40,590
3. Ditto	4,337 ×	7 =	30,359
4. Ditto	5,046 ×	2 =	10,092

Cubic yards up to 1837. 1,246,560 = 10 × . . 1,246,560

	Amount Expended. £.	s.	d.	Punt Loads.	
1838	5,555	7	4	13,540	4 Dredgers
1839	12,028	1	6	14,217	Ditto
1840	13,198	9	0	19,516	Ditto
1841	11,841	18	2	21,881	5 Dredgers
1842	13,612	11	3	31,381	Ditto
1843	9,742	7	6½	29,444	Ditto
1844	10,659	3	8	30,578	Ditto
	£76,637	18	5	160,557	
Upper Harbour				11,880	

Cubic yards, 1,724,370 = 10 × 172,437 . . 1,724,370

		£	s.	d.	£.	s.	d.
Cubic yards	2,970,930 at	1*s.*			148,546	10	0
Beacons, lights, and buoys		3,050	0	0			
Bowling basin, timber-work, stone-work, mooring pauls, &c.		2,580	0	0			
The excavation of Bowling Basin has been included in the above 2,970,930 cubic yards		..			5,630	0	0
Amount of deepening and river works, from 1770 to 1845		..		£.	215,156	17	6

In 1770 it will appear, by the table annexed, that a vessel at high water drawing less than 3 feet 3 inches could only ascend the Clyde to the harbour of Glasgow; at present a vessel drawing 17 feet 6 inches can sail up to the harbour at high water.

Estimate No. 1.

Mr. Smeaton, in 1755, states that he found the following depths at low
and which had been confirmed and more particularly stated in M

Distance from Glasgow Bridge.		Shoals in the River.	1755. High Water.		1755. Low Water.		1755. Rise of Tide.		1845. Present depth at High Water.		1845. Present depth at Low Water.		1845. Rise of Tide.		Increased depth from 1770 to 1845.	
Miles.	Furlongs.		Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
1	2	The Hirst	3	3	1	3	2	0	18	0	10	0	8	0	14	9
2	0½	Point House	3	8	1	6	2	2	18	0	10	0	8	0	14	4
3	1⅓	Holm Sand	4	0	1	6	2	6	18	0	10	0	8	0	14	0
4	1⅓	Marling Ford	4	0	1	6	2	6	18	0	10	0	8	0	14	3
5	0½	Blarthill Sand	4	9	1	6	3	3	18	0	10	0	8	0	13	0
5	5	Pudzock	6	0	1	6	3	6	18	0	10	0	8	0	12	0
														6)	82	4
															13	9

Appendix C.
Supplement.
Glasgow.
No. 498.
Estimate of deepening the Clyde.

Amount of Harbour Works.

	£. s. d.	£. s. d.
726,000 cubic yards of excavation in forming harbour, and deepening it, at 1*s*.	36,300 0 0	
Area, 30 acres, 5 yards deep :— 4,840 × 30 = 145,200 square yards. 145,200 × 5 = 726,000 cubic yards.		
7200 lineal feet of quay walls, including 516 lineal feet of timber quays in the upper harbour, at 40*l*. per foot, including the expense of making sheds, purchase of water-pipes, mooring-pauls, cranes, gas-pipes, lights, and causewaying, with sewers	288,000 0 0	
Amount of harbour works		324,300 0 0
Amount of river works		215,156 17 6
Total amount of the expense of the execution of the works in the River Clyde and Harbour of Glasgow, from 1770 to 1845, exclusive of the purchase of land £.		539,456 17 6

Estimate No. 2.

Deepening the Clyde 18 feet at High Water.

Miles.	Length. Yds.		Breadth. Yds.		Depth. Yds.	Cubic Yards.	
5 × 1760	8800	×	63	×	4	2,217,600	From harbour to Clyde Bank.
2½ × 1760	4400	×	70	×	4	1,232,000	To west end Newshot Isle.
2½ × 1760	4400	×	90	×	2	792,000	To west end of Dumbuck Ford.
	2100	×	100	×	2	420,000	Dumbarton, Garmoyle, and Port Glasgow Banks.
						4,661,600	

	£. s. d.	£. s. d.
4,661,600 cubic yards excavation at 9*d*.	174,810 0 0	
River dykes, say	50,000 0 0	
Buoys, lights, and beacons . . .	3,050 0 0	
Bowling Basin	2,580 0 0	
Amount of river works . .	..	230,440 0 0
Amount of harbour works (exclusive of land), as detailed in Estimate No. 1		324,300 0 0
Total		554,740 0 0

The amount of this estimate is to deepen the River Clyde, as it is at present, to form the harbour, and complete the quays, sheds, &c., as at present, considering the River Clyde to be in its original state as Mr. Smeaton found it in 1755, and Mr. Golborne in 1768, and which is exclusive of the purchase of land.

Mr. Golborne in his Report, dated 1768, states as follows:—

Distance from Glasgow Bridge. Miles.	Fur.		Ft.	In.		
1	2	The Hirst Shoal is	1	0	deep at	low water
2	0½	Point House	2	0	,,	,,
3	1½	Holm Sands	1	6	,,	,,
4	1½	Marlingford	2	0	,,	,,
5	0½	Blarthill Sand	1	6	,,	,,
6	5	Pudzock	2	0	,,	,,
7	2	At each end of Newshot Isle the depth is not more than	2	0	,,	,,
8	1	From Newshot Isle to Kilpatrick Sands	8	0	,,	,,
10	1	Kilpatrick Sands	2	0	,,	,,
		Between Kilpatrick Sands and Dumbuck Ford, the depth is from	16	0	to 18 feet	,,
11	4	Opposite Dunglass Castle	24	0		,,
		From Port Glasgow to Dumbuck Ford, depth not less than	12	0		,,
12	2	Upper Cairne, Dumbuck Ford	..			
		Mr. Watt states, in his Report, 1769, that Dumbuck Ford was 600 yards long, in which the depth is not more than . .	3	0		,,
		Mr. Smeaton states that the shoal at Dumbuck Ford is about half-a-mile long.				

In 1824 Mr. Clark states, in his Report, that vessels could sail up the Clyde, drawing 11 feet of water: this was about the period when the first steam-dredge commenced on the Clyde, being July, 1824,

APPENDIX C.

Supplement.

GLASGOW.

No. 498.
Estimate of deepening the Clyde.

and Mr. Clark's Report is dated November, 1824 Now, from the west end of Newshot Isle, up to the harbour of Glasgow, the River Clyde was deepened by the water-scour, allowing that the River Clyde was 12 feet deep at high water, in 1824, to a depth of 6 feet, as compared to what it was in 1770, when Mr. Golborne began his operations of constructing jetties; then the quantity carried away of sand and mud by the river and tidal scour will be as follows, the river being 18 feet deep at present:—

Miles.	Length. Yards.		Breadth.		Depth.		Cubic Yards.	
5	8800	×	63	×	4	=	2,217,600	
$2\frac{1}{2}$	4400	×	70	×	4	=	1,232,000	Cubic Yards
								3,449,600
$7\frac{1}{2}$								

Amount of deepening from Glasgow Harbour to Newshot Isle, from 1770 to 1845, river now 18 feet deep:—

Miles.								
5	8800	×	63	×	2	=	1,108,800	
$2\frac{1}{2}$	4400	×	70	×	2	=	616,000	
								1,724,800
$7\frac{1}{2}$								

Amount of deepening from Glasgow Harbour to west end of Newshot Isle, from 1770 to 1824, by the erection of jetties and parallel dykes 1,724,800

I have been anxious to look over this question more narrowly, as it has been one that no engineer that ever visited the Clyde, or reported upon it, has noticed, either as to quantity of sand and mud, &c., carried away from the Upper River down to the Lower Clyde, by the tidal and river scour arising from narrowing the river by jetties and dykes, producing shoals and banks, which have been most injurious to the navigation, and which did not exist in 1768, according to the Report of John Golborne.

Glasgow, January, 1847. WILLIAM BALD, *Civil Engineer.*

PAISLEY.

PAISLEY.

No. 499.
Wilson's Statement on the River Cart.

No. 499.

Statement relative to the River Cart.

Paisley, August 1, 1847.

THE Cart has its source in the county of Renfrew, through which it runs for about 20 miles, intersecting various towns and villages, including the manufacturing towns of Pollockshaws and Paisley. It flows into the Clyde, about three miles below the town of Paisley, which is the only portion of it that is navigable, the flow of the tide further up than Paisley being interrupted by a precipitous fall in the immediate vicinity of the town.

In 1787, the magistrates and town council of Paisley obtained an Act of Parliament, authorizing them, at the corporation's expense, to improve the river, "and to make and keep the said River Cart navigable, in ordinary spring tides, for vessels drawing 7 feet of water, from the said bridge, called Sneddon Bridge, to the River Clyde," and to make quays, &c. The river, about half a mile from the Clyde, was crossed by the Inchinan Bridge, to avoid which powers were also obtained by the said Act to make a navigable cut or canal, not less than 7 feet deep, and of 54 feet wide at the top, and 24 feet at the bottom, and to place a swing bridge over the same. For these purposes the magistrates and council were authorized to borrow money and to levy certain dues.

These improvements were effected; and the river was maintained by the magistrates and council in that state until the year 1835, at which time the debt owing by the river to the corporation, with accumulations of interest, amounted to 27,000*l.*

In 1835, another Act was obtained for still further improving the river. By this Act the management of the river was separated from the corporation affairs, but vested in the magistrates and town councillors of Paisley, as trustees for the purposes of the navigation. The trustees were authorised to borrow 30,000*l.* for the improvements; and the debt of 27,000*l.* due to the corporation was postponed to the said sum of 30,000*l.* to be borrowed. Under this new Act the trustees were empowered to deepen the river to 12 feet at neap tides, to widen the canal to 50 feet at bottom, and 86 at top, and to take down, widen, and re-erect the drawbridge.

These further improvements were commenced. A steam-dredging machine was obtained, and considerable alteration was thereby made in the depth of the river. The cut or canal was widened, and a handsome iron swing bridge, of 50 feet span, was erected. A new quay was also erected in Paisley. The improvements continued to progress until the year 1841, when the pecuniary affairs of the corporation having become involved, and the trustees of the navigation having become unable to meet the demands upon them, both concerns became bankrupt. At the stoppage of payments in 1841, it was found that the debts incurred for the improvements under the Act of 1835 amounted to 22,000*l.*

In 1843, an Act was obtained for regulating the pecuniary affairs of the town of Paisley; and the management and direction of the River Cart was vested in a body of temporary trustees, for behoof of the creditors upon the navigation. Since 1841, no improvements have been made on the river, except certain repairs to maintain the river and banks. The present depth of the river is about 9 feet at ordinary spring tides, and vessels of 80 tons burthen navigate it up to the quay at Paisley.

Prior to the formation, in 1836, of the line of railway running from Paisley to the Clyde at Renfrew, and particularly prior to the formation of the Glasgow, Paisley, and Greenock Railway, a very considerable traffic existed in the conveyance of passengers, by small boats, to the steam-vessels on the Clyde, and a steam-boat also plied on the Cart, from Paisley to the watering-places on the west coast; but the facility given to passengers by these lines of railway entirely superseded the passenger traffic on the River Cart. The dues received are now solely from goods, consisting of a variety of articles.

During the years ending May 28, 1845, 1846, and 1847, the dues were farmed out, and the arrivals cannot be got; but the following table shows the arrivals and tonnage in the year 1844, and in the months of June and July last:—

APPENDIX C.

Supplement.

PAISLEY.

No. 499.

Wilson's Report on the River Cart.

River Cart.

Arrivals during year ending May 28, 1847 :—

Vessels	747	Tonnage	23,676
Rafts	55	,,	2,211
	802		25,887

Arrivals during the months of June and July, 1847 :—

June.

Vessels	114	Tonnage	3516
Rafts	5	,,	133
	119		3649

July.

Vessels	92	Tonnage	3095
Rafts	13	,,	389
	105		3484

June and July together.

Vessels and Rafts . 224 Tonnage . 7133

Revenue of River for year ending November 30, 1844	£384	10	11½
,, as rental for year ending May 28, 1845	411	0	0
,, ,, 1846	402	0	0
,, ,, 1847	400	0	0

Revenue for month of June, 1847	£49	19	6½
,, ,, July, ,,	62	16	3
	£112	15	9½

550*l.* to 600*l.* expected for year ending May, 1848.

The trustees have not to complain of any encroachment on the line of the river; but the navigation is much hurt, and indeed the use of the new quay is nearly totally destroyed, by accumulations of seeds poured into the river from flour mills, situated above the town of Paisley, and out of the jurisdiction of the trustees. If the Tidal Harbours Commissioners have any powers to prevent such an evil, they are respectfully requested to exercise the same.

ROBERT WILSON,
Clerk to the Trustees of the River Cart.

No. 500.
List of Printed Queries.

No. 500.

Printed Queries circulated to the several Ports and Harbours.

1. How situated—in a bay, or river, or open coast?
2. Sheltered, or exposed to what winds?
3. Natural or artificial, open, bar, pier, or tidal harbour?
4. Capacity, or area of sheltered anchorage?
5. Quality of holding ground? General depth of water?
6. Area above two fathoms, three fathoms, &c.
7. Width and direction of entrance or entrances?
8. Depth of water at entrance at high and low-water springs?
9. If dry, to what extent from the pier-heads?
10. Rise of tide at springs and at neaps, and at extreme tides?
11. Time of high water on full and change days?
12. Rate of current or stream of tide? and the same in freshes?

Capability.—Supplies.

13. Number and areas of wet docks or floating basins? Tidal basins? Width of entrance?
14. Number of building slips and patent slips?
15. Number of graving docks? Width of dock-gates, and length of dock?
16. Extent of wharfage, and depth alongside the quay? Number and power of cranes?
17. What means of repairing steam machinery?
18. Number of men employed ship building?
19. Supply of provisions—of coal—of water—of stores—of masts?
20. Supply of coal fit for steamers—at what price? How readily?
21. Is there a low-water pier? Is there a floating depôt of steam coal?
22. Is fresh water abundant and led down to the quays?
23. Chief traffic—foreign, coasting, inland?
24. Inland communication—rivers, canals, railways, roads?
25. Tonnage belonging to the port—sailing-vessels, steamers?
26. Steamers—1st class, 2nd class, tugs, and ferry?
27. What the tonnage and horse-power of each?
28. Number and tonnage of all arrivals and sailings in the year—distinguishing foreign, coasting, and steamers?
29. Population of the port?
30. Seafaring population—seamen, coasters, fishermen, boatmen?
31. Number of seamen registered?
32. Do the masters or mates of ships pass any examination?
33. Is such an examination thought desirable?

Plans and Charts.

34. Recent plans of the port—date, scale, author?
35. Old plans—date, scale, author, probable accuracy?
36. Any plans showing projected improvements?
37. Any engineers' or other reports on the harbour.
38. Best charts of the coast? Sailing directions?

Engineering.

39. Present state of the harbour, or river up to the first bridge?
40. What changes have taken place in deepening?
41. Changes in shoaling, or in the set of the tides?
42. Changes owing to encroachments or natural causes?
43. Changes by the removal or deposit of ballast or shingle?
44. Changes by the discharge of sewers or drains of factories into the stream?
45. Changes by the erection of piers, weirs, bridges, or piles?
46. If artificial, by what authority made?
47. Proposed remedy for any damage caused?
48. Do existing laws give power to stop and remedy abuses.

49. Does the harbour show any tendency to silt up? At what rate?
50. If a bar form across the mouth—is it of sand, shingle, clay, or rock? Is it stationary or shifting?
51. What power of sluicing in the port? Does it do good?
52. Number of cubic feet of water per minute, and from what distance procured?
53. With what success is it used, and how often required?
54. What is the nature of the bottom, and is dredging of any efficacy?
55. Is any dredging machine in use—of what power? Length of ladders?
56. Number of tons or cubic yards dredged up by day—and expense per ton or cubic yard, including the cost of depositing it?
57. Where is the soil removed to?
58. Is it fit for ballast?

59. Quantity of ballast annually supplied, and where from?
60. Price of ballast per ton? Is it compulsory on shipmasters to take it from the Harbour Trust?
61. Is there a ballast quay?
62. Is ballast thrown over into the harbours?
63. Of what materials are the piers or quays built? Cost of stone per cubic yard?
64. Of what stone, and is it bored by the *pholas*, or *saxicava rugosa*, or any other animal?
65. What is the average, and what the maximum size of the stones used in the construction of the quays?
66. Of what timber, and is it bored by the *teredo navalis* or any other worm?
67. Has any precaution been taken against it, and with what success?

63. If a river, what is the extent of its basin or country drained by it?
69. Available amount of river back-water?
70. Amount of tidal back-water at spring tides? At neap tides?
71. Whole area of navigable river at high water?
72. Relative area at high and low-water springs?
73. How high up is the tide felt?
74. Has the rise of tide been measured carefully at different points up the river?
75. Are these points referred to one common *datum* line?
76. Where is the *datum* or zero line, and how marked?
77. To what distance from its mouth is the river navigable?
78. What distance to the first bridge?
79. Is the river much affected by freshes?

APPENDIX C.

Supplement.

No. 500.
List of Printed Queries.

Government, Lights, &c.

80. Is the harbour governed by trustees or commissioners, or by whom?
81. What their names and occupations, and are they resident?
82. Under what Acts of Parliament?
83. Expense of obtaining the Acts of Parliament?
84. Date of charter, if any?
85. What authority to levy dues?
86. Any exemption from dues at other ports?
87. Is any passing toll levied?
88. Qualification necessary for a trustee or commissioner?
89. Is there a resident engineer, harbour-master, or deputy?

Pilots, Lights, &c.

90. Under what board do the pilots act?
91. Number of pilots? Sufficient for the traffic? Charges?
92. Where do they pass their examination?
93. Is pilotage compulsory on all vessels?
94. Under what board are the lights, &c.? What light-dues are levied?
95. What coast or harbour lights or light vessels?
96. Do they burn gas, rape-seed oil, or sperm oil?
97. What is the number of burners, and the annual expense of maintenance?
98. Are there sufficient lights, buoys, beacons, and sea marks?

Income and Expenditure.

99. Amount of revenue of port? For some years back?
100. Distinguish dues on shipping from dues on goods?
101. Are any shore dues or anchorage dues paid to other than the Harbour Board?
102. Are the dues applied to other purposes than the improvement of the habour?
103. Is there any debt? what interest paid, and to whom?
104. Is there a sinking fund, and is it annually increased?
105. Annual expenditure, in detail?
106. Is any annual amount expended in repairs and improvements?
107. Total amount expended in improvements?
108. Total amount empowered to be raised by Act of Parliament?

Fisheries.

109. What the extent and value of the river and coast fisheries?
110. Number of smacks or boats, and men employed in them?
111. Number of trawlers and liners?
112. Do they supply the poor with cheap food?
113. Are they capable of extension if more capital were found?
114. Any asylums or endowments for decayed fishermen or seamen?
115. Any provision for pensioning their widows or educating their children?

Resources, &c.

116. Is land to be had easily for docks or slips if required?
117. Are there quarries of building stone in the neighbourhood, and what are the largest blocks that can be procured?
118. What is, briefly, the geological character of the country around? Are there coal-pits or mines?
119. Any shingle beaches in the vicinity?
120. Is there a life-boat, or rocket, or mortar, in case of wreck?
121. Is there an Admiralty chart agent resident?
122. Is a journal kept of the wind, weather, barometer, wrecks, &c.?
123. Is there a tide-scale? Is it registered daily, or is there a self-registering tide-gauge? And is this accompanied by a barometric register?
124. Can a ship be supplied with a chronometer near at hand?
125. Is there an astronomical clock, or the means of giving time to ships by a time-ball?
126. What distinguishing lights do steamers carry by night?
127. Is there any harbour of refuge in the neighbourhood?
128. Where do the chief wrecks occur, and what the cause?
129. Would a public local inquiry into the cause of shipwrecks, when they occur, tend to prevent their frequency?
130. Name the best point for a harbour of refuge along this coast?
131. What are the military defences of the harbour?
132. Suggest any works for improvement of port?
133. Or generally for the benefit of navigation in the neighbourhood?

INDEX.

Note.—The Small Numerals refer to the pages of the Report and the Roman Figures to the pages of Appendix and Supplement.

ABERDEEN:

Present Condition of Harbour:—

This port, with few natural advantages, is rapidly advancing in wealth and commercial importance, Rep. xxxi.—It now takes rank, in point of revenue, as the second port of Scotland, and has some of the finest steamers in the United Kingdom plying between Aberdeen and London, *ib.*—Description of the north pier, *Gibb*, 271.—The depth of water at the entrance mainly dependent upon the natural discharge of the river, and is little affected by tidal or backwater, *Abernethy*, 271.—The depth at the bar at high-water springs is over 21½ feet, *Morison*, 272.—The depth of water alongside the wharfs, 19 feet at ordinary spring tides, *ib.* 271.—The tide flows two miles up the Dee, *Abernethy*, 271.—The harbour subject to considerable swell in gales, *ib.*—It is rendered still more unquiet by the rebound of the waves from the south pier against the north capstan point, *ib.*—To lessen the disturbance, projected the slope on the south side of the entrance, *ib.* (*See* Improvements). Further evidence corroborative of the roughness of water in the harbour, and approving of the measures proposed to mitigate the evil, *Gibb*, 271; *Morison*, 272.—Gravel in considerable quantities is brought down during speats, causing sand-banks at the river's mouth, *Abernethy*, 271.

Lights.—The charge for maintaining the lights amounts to 335*l.* The revenue from this source is 305*l.*, *Reid*, 270.—Witness has charge of the tidal light, which is kindled at half tide, *Morrison*, 272.—Has a tide-gauge, but knows the quantity of water in the harbour without it, *ib.*—The light not hoisted when the weather is such as to render it dangerous for a vessel to enter the port, *ib.*

Dredging.—The harbour has been dredged, and the stuff deposited in the gaps of the banks or sand-hills, between the links and the sea, protecting them from the encroachments of the wind and sea, and forming valuable ground, *Abernethy*, 271.—The expenses incurred for dredging are upwards of 1000*l.* a-year, *Reid*, 270.—The steam dredge is of 17-horse power, and lifts 300 tons of soil a-day, at an expense of 4½*d.* per ton, Rep. xxxii.

Pilotage.—There are 40 pilots belonging to the port, who are examined by the Shipmasters' Society; most of them are fishermen, a few are seamen, *Morrison*, 272.—They are paid by the job; every vessel must take a pilot inwards, *ib.*—The smallness of their remuneration complained of, *ib.*

Management:—

The harbour and all its property belong to the town in right of various Charters, confirmed by subsequent Acts of Parliament, *Angus*, 269.—The first Act was obtained in 1773, the second in 1795, the third in 1797, the fourth, the chief Act for the improvement of the harbour, in 1810, *ib.*—In 1813 a supplemental Act was obtained, and in 1829 another Act for continuing the improvements according to Telford's plan, *ib.*—The last Act (1843), was for completing the improvements, constructing a wet dock, and various other works now in progress under Abernethy, the resident engineer, *ib.*—Prior to 1829 the management of the harbour was vested in the magistrates and council, *ib.*—The harbour, under the Act of 1843, is managed by 31 commissioners, viz. magistrates and town council, 19; burgesses of guild, 9; and members of incorporated trades, 3, *ib.*—Qualification of commissioners described, *ib.*—Twelve commissioners are elected under the Act; these comprise merchants, shipowners, &c., *ib.* 270.—[The Tidal Harbours Commissioners having inspected the different books, reported them to be kept in a very satisfactory manner, and further stated, that at no port had the queries of the Commissioners of Inquiry been so well answered as the returns from Aberdeen, 269.]

ABERDEEN—continued:

Income, Expenditure, and Debt:—

Income.—The income of the port has considerably increased, it has nearly doubled in the last 20 years, *Reid*, 269.—In 1810 the income amounted to 7214*l.* 11*s.* 9*d.*; in 1820, to 9378*l.* 11*s.* 11*d.*; in 1830, to 12,347*l.* 6*s.* 1*d.*; in 1840, to 17,87[illegible]*l.* 3*s.* 5*d.*; in 1845, to 23,760*l.* 8*s.* 7*d.*, *ib.*; and in 1846, 19,809*l.*, Rep. xxxi.—Account of income under different heads, 298.—The income in 1841 amounted to 22,356*l.* 1*s.* 7*d.*; in 1842, to 22,259*l.* 19*s.* 11*d.*; and 1843, to 28,783*l.* 8*s.* 2*d.*, 298; for 1844-5-6, see Supp. 654.

Expenditure.—In 1841, amounted to 21,943*l.* 7*s.* 1*d.*; in 1842, to 19,586*l.* 13*s.* 11*d.*; and in 1843, to 20,491*l.* 16*s.* 4*d.*, *Reid*, 298.

Debt.—The debt in 1810 was only 29,000*l.*: it has since increased to 186,676*l.* 5*s.* in 1845, *Reid*, 270, 298; 217,009*l.* due in 1846, Rep. xxxi.; Supp. 654.

Shipping and Tonnage:—

The trade of the port amounts to 322,000 tons, of which 24,000 are foreign and 298,000 coasting, *Reid*, 270.—The tonnage belonging to the port is about 45,000 tons, *ib.*—207 sailing vessels belong to the port, tonnage 38,062; and 14 steamers, 6438 tons, *ib.*—One of the steamers is 1100 tons burthen, *ib.*—In 1820 the arrivals were 1500, the tonnage 140,507; in 1840 the arrivals were 2246, the tonnage 248,598; in 1845 the arrivals were 2234, the tonnage 285,490, *ib.* In 1846, the arrivals were 2234 vessels of 285,490 tons, Rep. xxxii.

Improvements Generally:—

The rights of the salmon fishers a great obstacle to improvements in the harbour, *Abernethy*, 271.—Witness is a salmon fisher, and does not consider that the projected improvements would be injurious to the fisheries, *A. Hector*, 272; *J. Hector*, 272.—The diversion of the stream would even improve the fishings, as it would afford additional means of fastening the nets which at present are much wanted, *A. Hector*, 272.—The value of these rights estimated at from 70,000*l.* to 80,000*l.*, *Torrie*, 272.—Their present value not half the lowest of these sums, *Hector*, 272.—They are worth about 2000*l.* per annum, *A. Hector*, 272; *J. Hector*, 272.

Improvements Effected and in Progress:—

Formerly the bar was nearly dry at low water, *Abernethy*, 270.—Has seen people walk across the bar at the mouth of the harbour, *Morison*, 272.—It is now almost if not altogether removed, *ib.*—The channel at the bar has been deepened three feet, *ib.* 272.—The north pier projected and built by Smeaton to protect the entrance from being choked up with sand, and to carry the deposit brought down by the river more within the influence of the tidal current so as to ensure its being carried away, *ib.* 270.—It was afterwards extended by Telford in 1810, *ib.*—The embankment from Point Law westward carried out under witness's recommendation, and has been productive of considerable benefit, *ib.* 271.—The harbour has been considerably widened, *ib.* 270.—Statement of several works effected and in progress, *ib.* 271.—Description of the works and evidence as to their sufficiency, *ib.*—1000 feet of new wharfage will be completed in April, 1847, *ib.*—The dock will be completed and ready for the reception of vessels at the end of the year 1848. It will contain 34 acres, the lock 60 feet wide, 250 feet long between the gates; 21 feet water on the sill, the single entrance 70 feet wide, *ib.*, Rep. xxxii.

Lights.—Leading lights were erected at witness's suggestion, instead of a cast-iron light-house, as at first proposed, *Abernethy*, 270.

Improvements Suggested:—

To remove the sand-banks, recommends the removal of Abercrombie's Jetty, *Abernethy*, 270.—Believes an alteration of the course of the river would be

Aberdeen—continued:

Improvements Suggested—continued:—

attended with great advantages, *ib.* 271.—It would considerably deepen the entrance channel, *ib.*—Considers the proposed alteration of the river so advantageous that the obstructions caused by the right of the salmon fishers should be removed by purchase of their rights, *Gibb*, 272.—Does not consider that the diversion of the Dee would prove injurious to the salmon fisheries, *Hector*, 272.—Approves of the proposed diversion of the river, *Hadden*, 272, Rep. xvi.—By this diversion they will gain 80 acres of valuable land, and at the same time improve the harbour, *Hadden*, 272.—Projected the formation of a paved slope on the south side of the harbour entrance, *Abernethy*, 270.—This work would be of advantage, *Gibb*, 271.—Slope should be 1 in 15, *ib.*

Breakwater.—A breakwater proposed by witness, giving 20 acres of good and safe anchorage, with a depth of 25 feet at low water ordinary spring tides, *Abernethy*, 271.—This work will form an excellent harbour of refuge, and effectually protect the present harbour entrance, *ib.*—The "*Newcastle*" schooner rode at anchor in a gale for 24 hours within the space proposed, and sunk at her moorings, such the quality of holding ground, *ib.*—A number of vessels have been lost near the harbour mouth, which might have been saved if the breakwater had been erected, *ib.*—Stones for the breakwater might be got close at hand, *ib.*—The harbour funds not sufficient at present to meet the cost of this work, *ib.*—Considers that it ought to be a national work, as it would be productive of national advantages, *ib.*—Approves of the breakwater as proposed by Mr. Abernethy, *Gibb*, *ib.*—Several vessels have been wrecked which would have been saved if there had been a breakwater, *Morison*, 272.

Time Ball.—Considers the erection of a time ball on the top of Marischal College would be advantageous to the shipping, *M'Gillivray*, 272; *Berry*, *ib.*

Complaints:—

No complaints have been received relating either to harbour dues or to any other subject connected with the port, *Read*, 270.—Merchants have complained that they have been compelled to pay higher freights from their vessels getting aground. This will be avoided when the dock is completed, *ib.*—Repeated complaints have been made of the uneven bottom of the harbour; these mostly come from the steam companies whose vessels have fixed berths dredged to receive them, *Abernethy*, 271.—These complaints will be obviated by the wet dock *ib.*

Reports of Engineers, &c.

Smeaton, on improving the harbour, 273.—Rennie, on the same, with estimates, 275.—Telford, on the same, with estimates, 279.—Telford and Jessop, on the harbour, 280.—Walker, on the harbour and proposed docks, 281.—Walker, on the plan of Hogarth, Pirie, and Read, on the proposed improvements, 284.—Abernethy, suggesting construction of wet docks, with estimates, 286—289.—Abernethy and Gibb, on the proposed wet docks, 289.—Gibb, on improving the harbour, 290.—Leslie, on turning the course of the Dee, 293.

Miscellaneous Papers:—

Return to an Order of House of Commons of August, 1844, 272.—Report of Committee of Inhabitants on the improvement of the harbour, 294.—Return of receipt of customs' duties at Aberdeen from 1805 to 1846.—Return of income and expenditure in 1841, 1842, and 1843, 298.

ABERDOUR:

Is formed by a single pier on the west side of the Dour burn, and has 12 feet of water at spring tides, Rep. xxiv.—133 vessels, of 9135 tons, cleared out in 1846, laden chiefly with coal, *ib.*

Income and Expenditure:—

Income.—In 1842, 104*l.* 1*s.* 9½*d.*; in 1843, 109*l.* 6½*d.*; and in 1844, 128*l.* 3*s.* 8*d.*; *Glendinning*, 154.—The dues are collected under the authority of a charter granted to James Earl of Morton, in 1704, which was ratified by Parliament in 1705, and confirmed by successive renewals, and now vested in the present Earl of Morton, *ib.* 154, Rep. xxiv.; for income in 1844-5-6, see Supp. 656.

Aberdour—continued:

Income and Expenditure—continued:—

Expenditure.—In 1842, 74*l.* 16*s.* 5*d.*; in 1843, 45*l.* 3*s.* 3*d.*; and in 1844, 13*l.* 0*s.* 11*d.*; *Glendinning*, 154.

ACKERGILL:

Goods and passengers are landed at this place when Wick cannot be approached, *Medley*, 373.—A low-water pier would afford great accommodation to passengers and for shipment of cattle, Rep. xli.—The bay is extensive, and has excellent anchorage, *Medley*, 373.—Has seen more than 40 sail at one time in the bay during westerly gales, *ib.*—The large number of vessels taking shelter here, and the numerous wrecks on Keiss Sand, show the necessity of a pier harbour, *ib.*—A lighthouse about to be erected at Noss Head, Rep. xli.

ALLOA:

Present Condition of Harbour;—

The dock and quay walls of this port, notwithstanding it has considerable trade, are much out of repair, and are falling into the stream, Rep. xxii.

Management:—

Several Acts of Parliament have been passed granting powers to raise money to carry out improvements, *Jameson*, 150-1.—The Act of 1786 the governing Act under which the present trustees act, *ib.* 150.—This Act gave more extensive powers to levy dues and to improve the harbour, *ib.*

Income and Expenditure:—

Income.—In 1842, 634*l.* 12*s.*; in 1843, 591*l.* 19*s.* 2*d.*; in 1844, 920*l.*, 153; and in 1845, 725*l.*, Rep. xxii.; for 1845-6, see Supp. 654.—Anchorage dues levied under the 26 of Geo. III., cap. 13, and the duties on goods under the 43 of Geo. III., cap. 55, 153.

Expenditure.—In 1842, 483*l.* 16*s.* 6*d.*; in 1843, 616*l.* 6*s.* 5*d.*; and in 1844, 941*l.* 2*s.* 3*d.*, 153.

Shipping and Tonnage:—

The arrivals and sailings in 1846 were, 776 vessels of 51,115 tons, of which 137 vessels were either foreign or colonial, Rep. xxii.

Improvements Effected:—

A new stone pier on south side of east pier built since 1826, by which additional accommodation was obtained, *Jameson*, 150.—The harbour has been widened and land purchased on the south side of the harbour for the purpose of erecting wharfs and warehouses, *ib.* 180.

Improvements Suggested:—

The formation of a wet dock for the accommodation of large ships and vessels belonging to the port employed in the North American trade much desired by the trustees, *Jameson*, 150.

Reports of Engineers, &c.

Stevenson and Bald, on the formation of a wet dock, and estimate, 1826, 151.

Complaints:—

The practice of ship-masters throwing their ballast into the Forth prevails to a considerable extent, and is very generally complained of, *Jameson*, 151.—Extent of the evil described, *ib.*—Shoals and sandbanks have increased in the river from the prevalence of this injurious practice, Rep. xxii.

ANNAN:

Description of the harbour, Rep. lix.—A free port, with a quay partly public and partly private property, *Sawyer*, 613.—A small toll only is collected, *ib.*—The harbour is formed by the sea-reach of the river Annan, which falls into the Solway Firth, about 1½ mile below the town, *Supplement*, 613.—A mill-dam dyke crosses the river 100 yards below the bridge; half a mile further down the south-eastern bank is quayed for a short distance, *ib.*—At this spot there are two pile-jetties, belonging to the Steam-packet Company at Annan, Waterfoot, *ib.*—The tide rises here 20 feet at springs, and flows 2 miles above Annan bridge, *ib.*—Neap tides rise to 14 feet, *ib.*—A rocky bar of freestone, 200 yards in extent, crosses the river about a mile from the outfall to the sea, *ib.*—Vessels drawing 12 feet of water can come up to the jetty at Waterfoot in all tides at half flood, *ib.*—The English Channel of the Solway up to Waterfoot is well lighted and buoyed, *ib.*—Description of

ANNAN—continued:

the lights, *ib.*—Some buoys might be placed with advantage at the entrance of the river, *ib.*—Thirty-one sailing vessels belong to the port, of 2345 tons, *ib.*—The arrivals in 1845 were 544 coasters, 57,550 tons, and 8 foreign vessels of 1427 tons, *ib.*—Evidence as to trade, population, and proposed railroad, *ib.*; for income in 1844-5-6, see Supp. 654.

ANSTRUTHER:

Is enclosed by north and south piers, with an entrance 111 feet, Rep. xxv.—This port has an area of six acres. It is of insufficient depth, having only 10 feet alongside the pier, *ib.*—The arrivals in 1846 were 202 vessels of 9719 tons, *ib.*—66 vessels of 3098 tons belong to the port, *ib.*

Management:—

Vested in the magistrates and Town Council by purchase of chartered rights, granted to the Anstruther family in 1564 and 1580, *Darcie*, 163.

Income and Expenditure:—

Income.—In 1841, 161*l.*; in 1842, 161*l.*; and in 1843, 172*l.*, *Darcie*, 164; for 1844-5-6, see Supp. 656.

Expenditure.—In 1841, 17*l.* 10*s.*; in 1842, 20*l.* 10*s.*; and in 1843, 11*l.*; *Darcie*, 164.

Plans and Surveys:—

A plan of the harbour was made several years since by Mr. Stevenson, which, at present, is in possession of the engineer of the Board of Fisheries, *Darcie* 164.

ARBROATH:

Present Condition of Harbour:—

The area of the old inner harbour is two acres, of the new inner harbour, 3 acres; of the new outer harbour, one acre; total, six acres, or seven acres, including the outer breakwater, *Leslie*, 244, Rep. xxix.—The outer entrance is 100 feet wide, the inner entrance to the new harbour 50 feet wide, and to the old harbour 27 feet, *Leslie*, 244.—The wharfage is 800 yards long, *ib.*—Without the harbour a rocky flat, dry at low water, extends 230 yards to low-water mark, *ib.*—At a cable's length from this it is 18 feet deep, and a quarter of a mile further, six fathoms deep, *ib.*—The tides rise 16 feet in springs and 9 feet in neaps, *ib.*—Vessels once inside lie safely, *Kidd*, 245.—The deposit in the harbour is about 6 inches per annum, *Leslie*, 244.

Fishery.—The white fishery is extensive, and employs 20 boats, *Macdonald*, 244.—The sea-faring population amount altogether to about 820 persons, of whom 300 are employed in vessels trading foreign, 400 in coasters, and 120 fishermen, *ib.*—There is a patent slip, three building yards, with five building slips, giving employment to 50 shipwrights, *ib.*—A railroad communicates with Dundee, Forfar, and Aberdeen, *ib.*—Supplies of all sorts of provisions; water and coal are abundant and cheap, *ib.*

Obstructions.—The Knuckle Rock and Cheek Bush are two dangerous rocks, dry at very low springs, *Leslie*, 244.

Pilotage.—There are 20 pilots, who are examined by witness and licensed by the trustees; they are paid by the job and not by salary, *Kidd*, 245.

Lights.—There is one tide light at the pier head; it is only shown when a vessel is off the port, *Kidd*, 245.

Management:—

Prior to the Act of 2 Vict., cap. 16, the harbour was governed by the magistrates and Town Council of the burgh under a charter of James VI., and its revenues expended for watching, lighting, paving, &c., *Macdonald*, 244.—The new Act vested the harbour in 19 trustees and gave power to raise 50,000*l.*, *ib.*—The accounts are audited by an independent auditor appointed for the purpose, and an abstract printed and published annually, *ib.*—[The Tidal Harbours Commissioner, after an inspection of the different books, reported them to be properly kept and in good order, and that the manner in which the several answers to the printed queries of the Commissioners were made was highly creditable to the trustees, *ib.*]

Income, Expenditure, and Debt:—

Income.—In 1845 the revenue amounted to 3271*l.*, *Macdonald*, 244.—It exceeded the income of 1844 by 335*l.*, *Kidd*, 245.—Statement of the shore dues from 1727 to 1845, *ib.* 251.—The dues are collected under 2 Vic. cap. 16, *ib.* 252.—Account of the revenue under different heads in 1845 and 1846, in 1841 the income amounted to 3346*l.* 13*s.* 8*d.*, in 1842 to 2858*l.* 19*s.* 10*d.*, and in 1843 to 3050*l.* 15*s.*, *ib.* 252.—In 1846 it had increased to 3,333*l.*, Rep. xxix.

Expenditure.—The expenditure amounted in 1841 to 1873*l.* 18*s.* 7*d.*, in 1842 to 2206*l.* 5*s.* 11*d.*, and in 1843 to 2555*l.* 12*s.* 11*d.*, *ib.* 252.

Debt.—A debt of 54,012*l.* was incurred for the improvements in the harbour, interest for half of which is paid at the rate of 5 per cent., and the other half at 4 per cent. to the creditors in the town, who came forward and gave their personal guarantee for the bank credit obtained by the trustees, *Macdonald*, 244.—The debt due on the 1st January, 1846, amounted to 53,514*l.*, 252.

Shipping and Tonnage:—

In 1845, the arrivals were 848, vessels of which 79 were foreign, *Macdonald*, 244.—Aggregate tonnage 47,607 tons, *ib.* 244.—In 1846 the tonnage had increased to 57,803 tons, Rep. xxix.

Shipwrecks:—

Statement of shipwrecks in the vicinity of Arbroath from 1796 to 1845, *Macdonald*, 250.—This statement does not include all the wrecks, as no record is kept, only those recollected are specified, *ib.* 250.

Plans and Surveys:—

There are two plans of Arbroath, one showing the harbour in its present state, and the other the harbour as it will be when all the improvements as sanctioned by Parliament are carried out, *Macdonald*, 245.

Improvements Effected and in Progress:—

The harbour has been repaired and enlarged under Mr. Leslie, a sea wall, a new outer harbour, and other works, have been constructed, giving double the former accommodation for the shipping and trade, *Macdonald*, 244.—58,000*l.* have been expended since 1839, in improving the harbour, *ib.*—The harbour has been greatly improved during the last ten years, *Kidd*, 245.—The plans of improvement are far from being completely carried out, Rep. xxx.

Improvements Suggested:—

The works projected, but not carried out from want of funds, are, converting the old harbour into a floating basin, removing the old piers and deepening the entrance, Rep. xxx.—Deepening the approaches and harbour to a depth of 3 feet, which is generally desired, is prevented by want of funds, *Macdonald*, 244; *Kidd*, 245.—Deepening the entrance of the utmost importance, and should be accomplished at almost any sacrifice, *Leslie*, 244; Rep. xxx.—A channel 100 feet wide and 3 feet deep for 230 yards is absolutely necessary, *Leslie*, 244.—This might be done for 10,000*l.*, and as it would give a depth of 15 feet at the entrance at high-water springs and 12 feet at neaps, considers it would double the traffic of the port, *ib.* 245.—Unless the entrance is deepened 3 feet the expense already incurred will be comparatively valueless, *Kidd*, 245.—The outer harbour must be deepened, the old pier removed, and the new middle quay wall built, *ib.*—A sluice introduced into the new harbour in connexion with the Brothok would help to scour away the silt, *ib.*—The aid of Government earnestly desired to carry out the projected improvements, as the increased accommodation would increase the traffic, and thus pay off the debt, *Macdonald*, 244.

Removal of Obstructions.—The Knuckle Rock and Cheek Bush, two dangerous rocks, dry at low springs, should either be blasted away or have beacons on them, *Leslie*, 244; Rep. xxix.

Complaints:—

No written complaints have been received, but many verbal complaints have been made to the trustees of the want of sufficient depth of water, 245.

Miscellaneous Papers:—

Return to Order of the House of Commons of August, 1844, 245.—Memorial of magistrates, &c., of Arbroath to the Lords of the Treasury, 245.

ARBROATH—continued:

Miscellaneous Papers—continued:—

—Memorials of harbour trustees to Tidal Harbour Commissioners, 247-249. — Leslie's estimate for deepening the dock, 249.—Complaint of master of the barque "Hants" of Aberdeen, of delay in making the harbour from want of sufficient depth of water, 250.—Statement of shipwrecks on the vicinity of Arbroath, from 1796 to 1845; statement of shore dues from 1727 to 1845, 251.

ARDRISHAIG AND CRINAN CANAL:

Description of the canal, Rep. xliv.

Ardrishaig.—This port necessary to afford shelter to vessels entering and departing from the Crinan Canal, *Thomson*, 378.—The south side of the harbour is sheltered by a stone pier, extending 170 yards in an easterly direction, with a harbour light at the pier head, Rep. xliv.—On the north side is a steam-boat pier, 45 yards long, *ib.*—It is the most important steam-boat station on Lochfyne, and is also much frequented in the season by the fishing boats, *Thompson*, 378.—Wharfage accommodation complained of as insufficient, *ib.* 379.—The harbour should be deepened and the breakwater extended, *ib.*

Crinan.—The western extremity of the canal, besides the canal traffic, is becoming a station of growing importance for steamers, *Thomson*, 379. —The want of accommodation at this place also complained of, *ib.*—A breakwater for shelter and wharfage ground are much wanted, *ib.*, Rep. xlv.

Income, Expenditure and Debt:—

Income.—In 1842, 396*l.* 13*s.* 5*d.*; in 1843, 472*l.* 6*s.* 7*d.*; and in 1844, 353*l.* 11*s.* 9½*d.*, *Thomson*, 378; for 1844-5-6, see p. 656.—The dues are levied by the Caledonian Canal Commissioners, under the authority of the Crinan Canal Act, *ib.* 378.

Expenditure.—In 1842, 116*l.* 1*s.* 11*d.*; in 1843, 599*l.* 6*s.* 9*d.*; and in 1844, 424*l.* 3*s.* 4½*d.*, *Thomson*, 378.

Debt.—Was contracted for building the steam-boat pier, in 1836, *Thomson*, 379.—Amount due January 7, 1846, 1591*l.*, *ib.*

ARDROSSAN:

Descriptive statement of the formation and progress of the harbour of Ardrossan, 519.—Further statement respecting capabilities of the harbour, 524.—Present state of the harbour, Rep. liv.

Income and Expenditure:—

Income.—In 1842, 855*l.* 16*s.* 11¾*d.*; in 1843, 702*l.* 5*s.* 1½*d.*; and in 1844, 863*l.* 13*s.* 8½*d.*, *Johnston*, 533; for 1845-6, see p. 656.—The dues are levied under 5 Vic., cap. 62, *ib.* 533.

Expenditure.—In 1842, 982*l* 7*s.* 11*d.*; in 1843, 803*l.* 0*s.* 10*d.*; and in 1844, 709*l.* 8*s.* 11¾*d.*, *Johnston*, 533.

Reports of Engineers, &c.:—

Jessop, on the extension of the pier, and estimate, 1808, 523.—Telford, on the best means of obtaining an extensive and commodious harbour at Ardrossan, 1812, 525.—Rennie, on the state and capabilities of the harbour, 1811, 524.—Walker, on the same, 1839, 526.—Moffatt, on the capabilities of the harbour after completion of the works in progress, 1844, 529.—Extracts from Grainger's and Miller's reports on the expense of forming docks and wharfs, 1839, 529.

ARGYLL CANAL:

Description of the canal, Rep. xlvi.—Report by Captain Sir Edward Belcher, R.N., dated 1847, on the proposed Argyll Canal uniting East and West Lochs, Tarbert, 640.

ARRAN, ISLE OF:

Description of the harbours, Rep. xlvii.

AVOCH, OR AUCH:

Has a small pier harbour, sheltered by a breakwater to the eastward, built in 1814 at a cost of 1056*l.*, Rep. xxxviii.

AYR:

Present Condition of Harbour:—

Is formed by the mouth of the river, which falls into the sea, between piers, having the entrance sheltered by a detached rubble-stone breakwater, with an opening 320 feet wide, Rep. lvi.—The bar (of sand) has 15 feet water over it at high-water springs, *ib.*—The banks of the river are quayed on each side from the bridge seaward, and affords 1200 yards of wharfage, *ib.*—The south quay was originally built in 1772, *Alexander*, 542.—The north pier was extended in 1800, *ib.*—The south pier was rebuilt about 20 years since, *ib.*—Considers that the piers answer the purpose for which they were built, *ib.*—The old quay walls are in a very dilapidated state, *ib.*—The stones of which it is built are too small, *ib.*—The freshets, which come very rapidly, have undermined the walls, *ib.* —The breakwater is 400 feet long; it was laid down in 1836, to enable vessels to lie more easily in the harbour in certain winds, *ib.*—It is built of rubble stones, but not faced on the inside as intended, *ib.*—It is up to high water at common tides, but is not high enough; the swell comes over it, *ib.*—Stones are occasionally thrown down on the inside in severe gales, *ib.*—It should be completed to make it fully serviceable, *ib.*—Freshes run at the rate of five or six knots an hour, *Young*, 543.—It is now 5 feet deep at low water over the bar, *Alexander*, 542.—This depth has been obtained by dredging, *ib.*—The depth in the harbour is very irregular, *ib.*—It has been increased from 2¾ feet to 3 feet by dredging, *Young*, 543.—Evidence as to currents and the set of the tide, *ib.*; *Highet*, 543.—The tide flows as far as the Ayr mill-dam dyke, or about half a mile, *M'Clelland*, 542.—The harbour is easy to take in a gale, *Young*, 543.—The entrance is 320 feet wide between the south pier and the head of the breakwater, *Alexander*, 542.—There is good holding-ground in the bay a mile and a half off, *Young*, 543.—There are three cranes; one to lift six tons, the others three tons, *ib.* 542.—The patent slip proved for vessels of 400 tons, although larger ones could be taken up, *Gensmell*, 542.—It has been found a great accommodation, *ib.*—There is one building yard; the largest vessels built there are about 600 tons burthen, *ib.*—The export trade is chiefly in coal and freestone, *Young*, 543.—The trade of the port is increasing in consequence of the railway, *Highet*, 543.—Some vessels now frequenting the port are so large as occasionally to be compelled to discharge part of their cargoes before they can get in, *ib.*

Pilotage.—Pilots are licensed and examined by the trustees, *Wilson*, 540.—They are paid by salaries, *Gray*, 541.—Pilotage compulsory on all vessels above 50 tons, *ib.* 541.—A surplus of about 100*l* a-year remains after paying the expenses, *ib.* —There are five pilots; they do not complain of their pay being insufficient, *Highet*, 543.

Lights, Buoys, and Beacons.—The lighthouses built and lighted by the trustees, *Gray*, 541.—They are never visited by the Commissioners of Northern Lights, *ib.*—The harbour light is shown all night; the tide light from half flood to half ebb, *Young*, 543.—The lights kept by one of the pilots, *ib.*—Ascertains the tide by a tide mark, *ib.*—[The Tidal Harbour Commissioner considers this not sufficient; recommends a float to be kept inside the lighthouse, 543.]—Half-tides shown by a flag by day, *Young*, 543.—Has frequently been perplexed by the lights from the lime-kilns, *Skelly*, 544.—Considers there are plenty of buoys, *Young*, 543.

Dredging.—A steam-dredge was procured in 1837, at a cost of 1400*l.*, *Alexander*, 542.—It is only of 8-horse power; it is useful but not sufficient, *ib.* 542.—One of 20-horse power is wanted, *ib.*—In sand the dredge can work only 9¼ feet deep, but in gravel 10½ feet, *ib.*—It can only be worked from half-ebb to half-flood in smooth water, *ib.*—Dredging costs 5*d.* per ton, *ib.*—The stuff raised is thrown into the North Bay, *ib.* 543. —There is no probability of its coming back, *ib.*

The Bar.—The bar is of sand; it is reformed at every fresh, both in summer and winter, *Alexander*, 542.—Sometimes as much as 3 feet, or 10,000 tons of shingle, have been deposited on the bar in the course of one winter, *ib.*—The banks of the Ayr are mostly of sand and shingle, which the freshes undermine and carry away, *ib.*—South-west winds aid in clearing the bar, sweeping the sand into the north bay, *ib.*—Believes that clay is below the sand on the bar, *ib.*—The bar is about 100 yards

AYR—continued:

Present Condition of Harbour—continued:—

across, *ib.*—The channel is not more than 20 or 30 wide, *ib.*—It cannot be kept clean without dredging, *ib.*

Obstructions.—Boulders.—Opposite the new quay there are several large boulders in the river; some of them 2½ tons weight, *Alexander*, 543.—A diving-bell is wanted to lift them, *ib.*—Vessels frequently strained on the stones after heavy freshes, *Shelly*, 544.—*Mill-dam Dyke.*—This dyke is between 8 and 9 feet above the level of the bed of the river, *M'Clelland*, 542.—The dykes are impediments to the flow of the tide upwards, *ib.*

Management:—

The Act of 1835 the governing Act, *Wilson*, 540.—This Act repealed the 57 of Geo. III., *ib.*—The harbour formerly managed by the magistrates and Town Council under their charters of 1165 and 1265, *ib.*—There are twenty-four trustees, seven of whom are ship-owners, but none are sailors, *ib.*—Considers twenty-four trustees too many, and that the Board would be more effective with one-half that number, *Miller*, 544.—Trustees are empowered to raise 10,000*l.*, *Wilson*, 540.—Power of trustees ineffectual to prevent nuisances, *ib.*—They have no power to improve above the bridge, *ib.*—Difficulty of getting qualified parties to take an interest in the affairs of the harbour, *Miller*, 544.—Jurisdiction of trustees extends 350 yards north and south of the harbour, *ib.* 540.—Quarterly reports made by resident engineer, pilot, and treasurer, *ib.*—The accounts are duly and regularly audited, and are kept in the Custom House open to inspection, *Gray*, 541.—[The different books examined by Tidal Harbours Commissioner, who suggested certain improvements in respect to the signatures to be affixed to the accounts; and, with this exception, approved of the manner in which they were kept, *ib.*]

Income, Expenditure, and Debt:—

Income.—In 1842, 1600*l.* 12*s.* 5*d.*; 1843, 1402*l.* 1*s.* 8*d.*, and in 1844, 1627*l.* 14*s.* 3½*d.*, 554; for 1844-5-6, see Supp. 654.—The dues are levied under the authority of the Act of 1835, *ib.*—The tonnage dues are charged considerably less than allowed by the Act, *ib.*—Evidence as to dues, &c., *Gray*, 540.

Expenditure.—In 1842, 1594*l.* 11*s.* 3½*d.*; in 1843, 1408*l.* 2*s.* 9½*d.*, and in 1844, 1627*l.* 16*s.* 3*d.*, 554.—The expenditure for salaries about 125*l.* a-year, and dredging about 300*l.* a-year, *Gray*, 541.—The great bulk of the funds laid out in improvements, *ib.*

Debt.—The amount due on 1st January, 1846, was 2171*l.*, 554; *Gray*, 541; 6 per cent. interest is paid for it, *ib.*—Amount due 1st January, 1847, 1929*l.*, Rep. lvi.

Shipping and Tonnage:—

The trade of the port is greatly on the increase, *Young*, 543.—Upwards of 1000 coasters and 18 foreigners arrived in one year, *ib.*—The arrivals and sailings in 1846 were 2366 vessels of 135,393 tons; of these 28 vessels of 5915 tons were either foreign or colonial, Rep. lvi.

Improvements Effected and in Progress:—

A new quay 150 feet long was built in 1845, at a cost of 600*l.*, *Alexander*, 542.—The depth of water increased from 2 to 3 feet, by dredging, *Young*, 543.

Improvements Suggested:—

The completion of the breakwater, the construction of pools to enable steamers and sailing vessels to lie afloat secure from freshes, and the improvement of the bottom of the harbour, are the different improvements recommended, *Alexander*, 542.—The removal of the boulders by a diving-bell a necessary step towards improving the harbour, *M'Clelland*, 542.—Completing the breakwater would be a great benefit, *Young*, 543; *Highet*, *ib.*, Rep. lvi.—A wet dock is much wanted for timber vessels and coasters, *Young*, 543.—Docks on both sides of the harbour are required, *ib.*—The removal of the Mill Dam Dyke, which would enable the tide to flow a mile further, would tend to improve the harbour, *M'Clelland*, 542.—Increased depth of water in the harbour might be obtained by further application of the dredge, *Young*, 543.—More quayage is wanted on both sides, *ib.*; *Highet*, *ib.*—A diving-bell very much wanted, *ib.*

AYR—continued:

Complaints:—

Complaints are frequently made that sand and rubbish are constantly thrown into the river at various parts of its course, *Wilson*, 540; *M'Clelland*, *ib.*—Insufficiency of accommodation at the quay, *Alexander*, 542.—The wharfage frequently so taken up that vessels had to lie three abreast, *M'Clelland*, *ib.*; *Young*, 543.—Sometimes 50 or 60 vessels are in at one time lying four abreast, *ib.*, Rep. lvi.—Exemption of coal and freestone from duty complained of, *Gray*, 540; *M'Clelland*, 541; *Paul*, *ib.*; *Highet*, 543; *Miller*, 544.—Cause of this exemption stated, *M'Clelland*, 541; *Miller*, *ib.*—A rate of 2*d.* per ton on these articles would bring between 800*l.* and 900*l.* a-year to the harbour funds, *ib.* 544.

Miscellaneous Papers:—

Return by trustees of maps, plans, &c., 545.—Protest against a rate on coal, 1842, 551.—Statement relative to the harbour, *Gordon*, 1846, 552.

Reports of Engineers:—

On the improvement of the harbour, *Smeaton*, 1772, 545; *Stevenson*, 1830, 549.—On extending the piers and making a wet dock, *ib.* 1805, 547; *ib.* 1806, 548.—On the harbour lights, *ib.* 1841, 550.—On the choice of a site for proposed dock and estimate, *ib.* 1846, 552.

BALDOON:

The property of the Earl of Galloway, *M'Millan*, 595.

Income and Expenditure:—

Income.—From May 2, 1842, to November 22, 1844, 27*l.* 0*s.* 10*d.*, *M'Millan*, 595; for 1845-6, see p. 654.—Arising from dues at 2*d.* per ton register, *ib.*

Expenditure.—From May 2, 1842, to November 22, 1844, 52*l.* 7*s.* 2*d.*, *M'Millan*, 595.

BALINTRAED:

Three miles eastward of Invergordon; has a landing pier for the district nearly 100 yards long; built in 1820 at a cost of 2400*l.*, Rep. xxxviii.

BALLANTRAE:

Description of the harbour, Rep. lvi.—There is no pier at this place, although a jutting rock under which vessels come in affords great facilities for erecting a harbour, *Guthrie*, 555.—The Fishery Board have a plan of a harbour to cost 4,800*l.*, and will advance half that sum if the fishers and others locally interested will raise the other portion, *ib.*—It is feared that the money cannot be raised, *ib.*—A harbour at this place would be very useful to the fisheries as well as to the trade of the adjoining country, *ib.*

BALLAST:—

Injurious discharge of, in harbours and rivers, Alloa, Rep. xxii.—Stromness, *ib.* xli.—General remarks thereon, *ib.* lx.

BALMERINO:

Income and Expenditure:—

Income.—In 1841, 9*l.* 7*s.* 7*d.*; in 1842, 13*l.* 12*s.* 10*d.*; and in 1843, 14*l.* 17*s.* 1*d.*, *Rentoul*, 172; for 1844-5-6, see p. 656.—The dues levied under authority granted by the Barons of the Exchequer, in 1755, to the predecessor of the present proprietor, *ib.*

Expenditure.—In 1841, 19*s.* 6*d.*; in 1842, 1*l.* 15*s.*; and in 1843, 2*l.* 5*s.*, *Rentoul*, 172.

BANFF:

Present Condition of Harbour:—

This harbour has not been benefited by the different attempts to overcome the evils attending its position, Rep. xxxiv.—It consists of an outer and inner basin, having an area of about 4 acres enclosed by piers, Rep. *ib.*—Makeshifts have been adopted from time to time as any one defect became more prominent than another, until the interior has become a labyrinth of stone walls, *ib.*—A shallow bay, a river bringing down large quantities of sand, and exposure to north-easterly gales, are the natural difficulties to overcome in improving the harbour, *ib.*—The arrivals in 1846 were 190 vessels of 11,560 tons, *ib.*—The tonnage belonging to the port, 111 vessels of 8714 tons, *ib.*

Management:—

This harbour is managed by trustees acting under the Improvement Act of 1840, *Smith*, 332.

BANFF—continued:

Income, Expenditure, and Debt:—

Income.—In 1841, 800*l.* 12*s.* 2*d.*; in 1842, 745*l.* 1*s.* 8*d.*; and in 1843, 705*l.* 16*s.* 8*d.*, *Smith*, 335.—In 1846, 836*l.*, Rep. xxxv.

Expenditure.—In 1841, 584*l.* 17*s.* 8*d.*; in 1842, 585*l.* 7*s.* 9½*d.*; and in 1843, 440*l.* 3*s.* 8½*d.*, *Smith*, 335.—8071*l.*, Rep. xxxv.

Debt.—Amount due on January 1, 1846, 8201*l.*, *Smith*, 335.

Improvements Suggested:—

An entrance by a bold cut through the rocks to N W. the best remedy for existing evils, Rep. xxxv. —Want of funds prevents this from being done, *ib.*—The best steps now to be taken to improve the harbour are to close up the entrance to the new harbour; deepen and improve the entrance to the old harbour, and open a communication between them; shorten the central quay, and remove one or both of the small jetties, and make a beaching place at the upper end of the old basin; deepen the channel and harbour generally, and blast away the Bobby Leel Rock, *ib.*—Suggestions as to altering the course of the Dovern, *ib.*

Miscellaneous Papers:—

Memorial on damage done by storm, *Robinson*, 332. Refusal of Government to advance public money to complete the works, *Harrison*, 333.

Reports of Engineers, &c.:—

Telford on the damage by the storm to the works at Banff, with estimates, 333.—Bremner, on repairing the breakwater; Bremner, on the harbour, 334. —Abernethy, on improving the harbours, with estimate, 334.

BAELOCHAN:

No dues collected, *M'Adam*, 596.—In 1845 the income from dues for shipping amounted to 4*l.* 9*s.* 8*d.*; and in 1846 to 9*l.* 13*s.* 7*d.*, Supp. 654, 655.

BEACONS AND BUOYS:—

Want of—Coast of Inverness, Rep. xxxvii.

BERWICK-ON-TWEED:

Present Condition of Harbour:—

The harbour is formed by the outlet of the Tweed, which falls into the sea a mile below the bridge, between a stone-pier on the north and a long low sandy spit, serving as a natural breakwater on the south, Rep. xx. The entrance is 120 yards wide, with a depth over a rocky bar of 4 feet at low water and 19 feet at high water spring tides, *ib.*—Further description of the harbour, *Pattison*, 116.—The pier is founded on rock and on piles, and built of sandstone, *Thompson*, 116.—It is an upright pier, 2500 feet long; was completed in 1822, at an expense of 72,000*l.*, *ib.*—The foundations are not deep enough to allow of deepening the harbour without being secured, *ib.*—The stones of the parapet wall were originally too light, and many of them have been washed into the sea, *Pattison*, 116.—There are at present several stones loose on the face of the pier, which require immediate repair, *ib.*—Does not consider the bridge injurious, *ib.*—The tide flows as far as Norham Castle, eight miles above the bridge, *ib.*—Freshes cause much damage, occasionally bringing down trees and stones into the harbour, *ib.* 115.—From 40 to 50 vessels lie in the river, *Thompson*, 116.—Boundary of the harbour described, *Pattison*, 116.—Witness, 11 years since, lay afloat in a cutter drawing 13 feet of water, where at present there are not 6 feet, *Swinhoe*, 117. —The depth of water over the bar has not altered, *ib.*—Does not think the Shad is lower than formerly, *Wood*, 117.—The Shad is certainly higher than formerly, *Lindsay*, 117.—Pilot boats formerly could cross the Shad, which they cannot do now, *ib.*—The rental of the fisheries in the Tweed estimated at about 8000*l.*, 118.

Pilotage.—Pilots examined licensed by Commissioners, *Pattison*, 115.—Some have been suspended for misconduct, but no complaints have been made respecting their qualification, *ib.*—There are 12 pilots belonging to the port, *Wood*, 117.

Lights.—The light-house on the pier shows a fixed light and a tidal light, when there is a depth of 10 feet of water on the bar, *Pattison*, 116.

Life Boat.—Was purchased 11 years since, but has never been used, *Hay*, 117.—Believes that it is in good repair, *ib.*—The hull of the boat was perforated by a pistol bullet shot through the door of the store-house in which it is kept, *Weatherhead*, 117.

BERWICK-ON-TWEED—continued:

Management:—

Previous to 1808 the harbour was under the control of the corporation, *Pattison*, 115.—At that date it was transferred to eighteen Commissioners, appointed under the Act, *ib.*—The existing Commissioners are only fifteen in number; of these, three live at a distance; none are sailors, *ib.*—Meetings are held monthly, oftener, if necessary, and minutes of proceedings kept, *ib.*—[The Tidal Harbours Commissioner having inspected the Minute Book, detected an important omission, *ib.*] —Never heard any complaints of the constitution of the Board, *ib.*—Power to borrow money for public improvements under the governing Act not restricted to any amount, *ib.*—[The Tidal Harbours Commissioner adverted to the manner in which the accounts were kept, stating that they were not sufficiently explicit, and recommended certain improvements in classifying the different items, 115-117].—The town council have applied for a more explicit and detailed statement of accounts, but have no power to enforce its production, *Robertson*, 117.

Income, Expenditure, and Debt:—

Income.—The income has considerably increased in the last twenty years, *Thompson*, 115.—In 1810 the income amounted to 2545*l.*; in 1846 it had increased to 3239*l.*, *ib.*—Account of the income, under different heads, in the years 1842 to 1846, 138. —In 1846 the revenue amounted to 3239*l.*, Rep. vii. —Average of last three years, 3194*l.* 1*s.*, *Thompson*, 115.—The shore dues are levied to their full extent; the governing Act prohibits their reduction, *Pattison*, 115.—Tonnage dues levied only to one-fourth the amount allowed under the Act, *ib.*; *Thompson*, 115.—The dues have been reduced, but the income of the port has not fallen off, *ib.*

Expenditure.—An account of the expenditure, under different heads, in the years 1842 to 1846, 38.—Average expenditure of three last years, 1932*l.* 3*s.* 3*d.*, *ib.*

Debt.—The Commissioners borrowed 20,000*l.* in 1817, of which a balance of 1350*l.* remains unpaid, *Pattison*, 115.—The balance of the debt will all be paid off in the course of the present year, *ib.*; *Thompson*, 115.—1350*l.* remains due to the Exchequer Bill Loan Commissioners, and 9000*l.* to private individuals, *ib.*—Has, at present, a surplus of 1818*l.* in hand, which will reduce the debt to 8531*l.*, *ib.*—Interest is paid at the rate of 4 per cent. for the amount, *ib.*

Shipping and Tonnage:—

There are sixty vessels belonging to the port, *Thompson*, 116.—In 1846 the arrivals and departures were 1570 vessels of 109,895 tons, Rep. xx.

Shipwrecks and Lesser Damage:—

The "*Atlas*" was wrecked at the back of the pier, a Dutch vessel on the bar, in 1835, and the "*Cupid*," on Spittal Point, in 1838, *Wood*, 117.

Improvements Generally:—

The erection of a wharf on the south side of the river, and other improvements, deferred for the present, partly from want of funds, and partly to ascertain what effect the railways will have upon the revenue of the port, *Pattison*, 115.—The opposition of the owners of the fisheries in the neighbourhood to the erection of the pier caused great additional expense, and prevented the completion of the work, *ib.* 116.

Improvements Effected and in Progress:—

Quay walls have been built on the north side, near the bridge, and two steam-boat jetties lower down, Rep. xx.—A quay was also built, in 1836, on the south side, near the Carr Rock, *ib.*—The lighthouse on the pier erected in 1826 by Harbour Commissioners without charge, *Thompson*, 115.—The pier has been repaired, by placing heavier stones than those originally used, *Pattison*, 116.—Stones of three or four tons weight, 17 feet to the ton, have been used in the repairs, *ib.*—The river has been deepened 4 feet 6 inches from the bridge to the sea by dredging, *Thompson*, 116, Rep. xx.

Improvements Suggested:—

The Pier.—The pier requires immediate repair; several stones on the face of the pier are loose, and

BERWICK-ON-TWEED—continued:

Improvements Suggested—continued:—

some have been washed out, *Pattison*, 116.—Does not consider the pier will require any repair for five years, *Thompson*, 116.—[The Commissioner agrees with Mr. Pattison that the pier requires immediate repair, *ib.*]

The Bar.—The bar is of rock, and might be removed, *Thompson*, 116.—[The removal of the bar recommended by Commissioner, *ib.*]—No attempts have been made to remove the bar, *Thompson*, 116.

Tidal Signal.—To give notice of depth of water over the bar in day time, in bad weather, when boats cannot go out, *Wood*, 117.—Recommends a flag-staff on the lighthouse for this purpose, *ib.*—[This recommendation approved of by Commissioner, who expressed a wish that it should be complied with, *ib.*]—The flag-staff has since been erected, *ib.*

South Pier.—A landing place much wanted on the south side of the river, *Robertson*, 116; *Hay*, 116.—A timber, or open pile erection, to discharge vessels at all states of the tides, would suffice, *ib.*—Memorial of merchants, &c., on the necessity for further wharfage accommodation on the south side of the river, 131.—Memorial of ship-owners, &c., on the want of a breakwater, and proceedings thereon, 129.—Moor's Report in reply, 130.

Breakwater.—Recommends the erection of a breakwater, to extend out into the river from Coxon's Tower, *Hay*, 116; *Swinhoe*, 117; *Wood*, 117; *James Thompson*, 117.—This work would check the inroads of the sea on the north side of the harbour, and break the heavy swell caused by easterly gales, *Hay*, 116; *Chisholm*, 117; *Gowan*, 117; *Swinhoe*, 117; *Wood*, 117.—Erection of breakwater objected to by Mr. Moor, the late engineer, who proposed instead, an extension of the ballast quay 280 feet, 117.—Harbour Trustees objected to breakwater from Coxon's Tower, considering it would have the effect of diverting the stream more to the south, and endanger the permanency of Spittal Point, *ib.*—[The Commissioner believes that if not extended too far into the river, a breakwater from Coxon's Tower would not have the injurious effect apprehended, *ib.*]

Complaints:—

Management.—That the Commissioners are self-elected, and that the general interests of the port are neglected; that there are but few ship-owners, and not one sailor, at the Board, *Robertson*, 116, App. No. 2, Rep. xx.—Mode in which the accounts are made out generally objected to, Rep. xx.

Schedule of Dues.—Alleged to be unequal and unjust, and that it has not been revised since 1808; that while corn and salmon pay nominal dues only, the whale fishery and salt are heavily taxed, App. No. 72, Rep. xx.

Want of Accommodation, &c.—That the south side of the river (where the chief factories are) is without quay, jetty, or any landing-place whatever, App. No. 72, Rep. vii. That the foundation of the pier is so shallow that the harbour cannot be deepened, and that it is now much out of repair, *Robertson*, 116, Rep. xx.

Obstructions.—That Tweed Bridge, with its 18 norrow arches, heavy piers, and additional starlings, is a great obstruction to the fair scour of the tide, Rep. xx.

Reports of Engineers, &c.:—

Rennie, on the harbour, 1807, 119.—Rhodes' 1st Report, 1835, 120.—2nd Report, 1836, 121.—Cubitt, on the same, 1837, 123.—Rhodes' 3rd Report, 1838, 125; 4th Report, 1838, *ib.*—5th Report, 1838, 126.

Miscellaneous Papers:—

Return to Order of the House of Commons, 1844, 118.—Case, and opinion of council, relative to accounts of the harbour, 127.—Memorial of ship-owners, &c., on the want of a breakwater, and proceedings thereon, 129.—Memorial of merchants on the want of wharfage accommodation on the south side of the river, 131.—Guthrie, to the Tidal Harbour Commissioners, on the proceedings of the Herbour Board, 1846, 132.—Robertson, on the want of a pier or landing-place on the south side of the river, 1846, 136.—Revenue and expenditure in the years 1842 to 1846, 138.

BLACKPOTS:

Income:—

In the year ended November, 1842, 3*l.* 10*s.*; in 1843, 2*l.* 14*s.*; and in 1843, 3*l.*, 336; for 1844-5-6, see p. 654.—The dues are levied under the authority of the Earl of Seafield, the proprietor of the harbour, 336.

Expenditure—Nil, 336.

BODDAM:

Proprietary harbours formerly belonging to Bailie Robertson of Peterhead, *Gray*, 299.—Chiefly for the accommodation of fishermen, *ib.*—Mr. Brebner, Advocate of Aberdeen, and factor for Lord Aberdeen, has now charge of Boddam, *ib.*—The harbours are difficult to take in stormy weather, but safe when entered, *ib.*—They are well protected by outlying rocks Rep. xxxiii.—The depth of water at the mouth is considerable, *Gray*, 299.—The small harbour at the fishing village might be extended and have deep water at all times of the tide by connecting certain rocks, *ib.*—The north harbour is more protected by the rocks outside of it, *ib.*—69 boats and 165 men are employed here in the herring fishery, Rep. xxxiii.

BORROWSTOWNESS:

Present Condition of Harbour:—

This harbour has an area of one acre, enclosed by piers, Rep. xxi.—It is very easy of access, but is in a ruinous condition, from the falling off of the trade since the opening of the Canal at Grangemouth, *Henderson*, 144.—There are no plans of the harbour nor any written complaints, *ib.*—It is managed by trustees under the Act 6 and 7 Vict., cap. 69, *ib.*—The expense of obtaining the Improvement Act amounted to 900*l.*, more than double the annual income of the harbour and town, Rep. xxi.—The arrivals in 1846 were 719 vessels of 29,663 tons, *ib.*—The tonnage belonging to the port in the same year was 91 vessels of 5944 tons, *ib.*

Income, Expenditure, and Debt:—

Income.—In 1842, 190*l.* 3*s.* 2*d.*; in 1843, 217*l.* 17*s.* 9½*d.*; and in 1844, 343*l.* 11*s.* 2½*d.*, 144; for 1845-6, see p. 656.

Expenditure.—In 1842, 207*l.* 17*s.* 7*d.*; in 1843, 665*l.* 4*s.* 7½*d.*; and in 1844, 1095*l.* 7*s.* 10¾*d.*, 144.

Debt.—Amount of, due 31st December, 1845, 2400*l.*, 144.

BRIDGENESS:

A proprietary harbour for the coal traffic, Rep. xxiii.—The arrivals and sailings in 1846 were 396 vessels of 20,673 tons, *ib.*—Revenue 92*l.*, levied by consent, *ib.*

BROADHAVEN:

See description of, Rep. xl.

BRORA:

This harbour is maintained at the expense of the Duke of Sutherland, *Gunn*, 359.—No dues are levied; no Act of Parliament has been obtained for its government, nor are there any maps or reports respecting it, *ib.*—Accidents have occurred at various times from the shifting of the bar and the deposit of rocks and stones at its mouth, *ib.*—The removal of these obstructions all that is necessary for the trade of the port, *ib.*—Remarks on the advantages of Lock Roby for formation of harbour of refuge, *ib.*; Rep. xxxix.

BRUCEHAVEN:

A proprietary harbour erected for the shipment of coal, Rep. xxiii.—The arrivals and sailings in 1846 were 440 loaded vessels of 37,298 tons, *ib.*—Revenue 15*l.*, levied by consent, *ib.*

BUCKHAVEN:

A well-known fishing station, with 125 boats, employing 625 men and boys, Rep. xxiv.—The harbour has an area of about 3 acres, sheltered by circular piers, with an entrance 20 yards wide, *ib.*—The depth from 9 to 10 feet over rock, *ib.*—It cost 6000*l.*, three-fourths of which were contributed by the Fishery Board, *ib.*—Arrivals, in 1846, 23 vessels of 1230 tons, *ib.*; for income in 1844-5-6, see p. 656.

BUCKIE:

The small pier at this place has recently been completed by the fishermen out of their own resources, Rep. xxxv.—163 boats, manned by 815 men, are employed in the deep-sea fishery, *ib.*—Great want of harbour accommodation is felt throughout this

BUCKIE—*continued:*

district, which operates as a great discouragement to the fishery, *ib.*; for income in 1844-5-6, see p. 654.

BURGHHEAD:

A proprietary harbour granted by various royal charters, *Christall*, 338.—By a moderate outlay this harbour might be made the best harbour on the east coast of Scotland, *ib.* 339.—It has an area of about two acres, the entrance is sheltered by a pier extending 80 yards to the south-west, and continued by a timber jetty of similar length, Rep. xxxvi.—The port is quite sheltered, and may safely be taken at tide time, *ib.*—It is 16 feet deep alongside the pier at high-water springs, *ib.*—The arrivals in 1846 were 341 vessels of 22,477 tons, Rep. xxxvi.

Income, Expenditure, and Debt:—

Income.—In 1841, 332*l.* 2*s.* 5*d.*; in 1842, 335*l.* 13*s.* 11*d.*; and in 1843, 324*l.* 9*s.* 2*d.*, *Christall*, 339; 1844, 387*l.* 9*s.* 2*d.*; 1845, 411*l.* 11*s.* 4*d.*, and in 1846, 394*l.* 16*s.* 2*d.*, Supp. 656.—The dues are levied under a royal charter, *ib.*

Expenditure.—For repairs, dredging, and interest of loans, *Christall*, 339.—The harbour, erected at the sole expense of the proprietor, cost 24,325*l.*, Rep. xxxvi.

Debt.—The amount due on 1st January, 1846, was 23,369*l.*, *Christall*, 339.

BURNMOUTH:

Has an east pier, erected in 1830, for the accommodation of the fishermen by the Fishery Board, Rep. xx.—It has 29 boats, employing 145 men, Rep. xx.

BURNTISLAND:

Present Condition of Harbour:—

Vessels can take the harbour in any weather, and when in, are in perfect safety, *Hutchison*, 155.—It might be converted into a harbour of refuge at very little expense, *ib.*—A communication by steam ferry is kept up from this place across the Frith to Granton at all times, forming the collecting link wall to the Edinburgh and Northern line of railway, Rep. xxiv.—This is one of the best harbours in the Forth, and has a graving-dock capable of receiving a ship of 1000 tons, *ib.*—A low-water pier has recently been erected, 500 feet long, by a depth of 9 feet at low water, and 27 feet at high-water spring tides, *ib.*—The arrivals in 1846 were 365 of 14,114 tons, *ib.*—The Blae Rock, lying a mile off shore midway between Burntisland and Kinghorness, has only 17 feet of water over it at low-water springs, and should be buoyed, *ib.*

Management:—

Vested by various charters in the provost, bailies, and council of the burgh, *Hutchison*, 154, 155.—The last charter granted by Charles I. in 1632, and confirmed by Parliament in 1633, Rep. xxiv.

Income, Expenditure, and Debt:—

Income.—In 1641, 184*l.* 12*s.* 8*d.*; in 1842, 208*l.*; and in 1843, 167*l.* 4*s.* 8*d.*, 155; for 1844-5-6, see p. 656.

Expenditure.—In 1841, 32*l.* 17*s.* 8*d.*; in 1842, 45*l.* 11*s.* 7*d.*; and in 1843, 43*l.* 15*s.*, 155.

Debt.—500*l.*, due 31st December, 1845, 155.

CALEDONIAN CANAL:

Description of, Rep. xxxvii.

CAMPBELLTOWN:

Description of, Rep. xlv.—It was erected into a royal burgh by charter in 1700, under which the magistrates still act, *Harvey*, 379.

Income, Expenditure and Debt:—

Income.—In 1842, 161*l.* 12*s.* 6*d.*: in 1843, 150*l.* 13*s.* 1*d.*; and in 1844, 147*l.* 17*s.*, *Corvill*, 379; for 1845-6, see p. 654.—The dues are levied under the charter, *ib.*

Expenditure.—In 1842, 376*l.* 18*s.* 2½*d.*; in 1843, 333*l.* 10*s.* 11*d.*; and in 1844, 665*l.* 3*s.* 5*d.*, *Corvill*, 379.—The above includes the salaries paid to the officer of the town as well as of the harbour, the accounts not being separately kept, *ib.*

Debt.—Amount due on 1st January, 1846, 1395*l.* *Corvill*, 379; see Rep. p. 22.

CAPE WRATH:

Description of, Rep. xlii.—Landing-places for fishermen much wanted on this coast, *ib.*

CART RIVER:

Description of improvements in, Rep. li.—Wilson on the Cart, Supp. 669.

CARTY:

Income and Expenditure:—

Income.—In 1842, 16*l.* 17*s.* 4*d.*; in 1843, 15*l.* 9*s.* 10*d.* in 1844, 18*l.* 3*s.* 10*d.*, *M'Millan*, 596; for 1845-6, see p. 654.—Arising from dues, 2*d.* per ton register, *ib.*

Expenditure.—In 1842, 2*l.* 2*s.*; 1843, 16*s.*; 1844, nil, *M'Millan*, 596.

CASTLEHILL:

This is a private harbour, erected at the sole expense of the late Mr. Trail, *Purvis*, 374.—No dues are exacted, and the expenditure is confined to casual repairs, *ib.*

CELLARDYKE, OR KILRENNY:

A fishery harbour, with an area of 1½ acres, sheltered by a south-east pier and west spur; the entrance is 72 feet wide, Rep. xxv.—The east pier was extended in 1830 at the joint expense of the Fishery Board and the fishermen, *ib.*—The harbour is still so much exposed that, with the wind from the south-east or on shore, the fishermen are compelled at great risk to run for Anstruther or Elie, *ib.*—There are 102 herring-boats employing 510 men and boys, *ib.*—The income in 1844 amounted to 21*l.*; in 1845, to 19*l.* 5*s.*; and in 1846, to 20*l.* Supp. 655.—The swell might be lessened by narrowing the entrance and extending the east pier to the front of the rocks, Rep. xxvi.—A beach for the swell to expend itself upon, the great want of of the place, *ib.*

Craignoon, a little to the westward, is a favourable site for a harbour, and by taking advantage of the Sandling rock good shelter might be obtained, *ib.*—Leslie estimated the expense of a small harbour on this spot at 5800*l.*, but nothing has been done, *ib.*—Leslie on a projected fishing harbour at Craignoon, 1838, Supp. 665.

CHARLESTON:

Has an area of 5 acres in the two harbours, Rep. xxiii.—The piers protect the harbours from all winds, but the S.E., *ib.*—The arrivals and sailings in 1846 were, 1845 vessels of 118,273 tons, *ib.*—The income in 1846 amounted to 544*l.*, *ib.*—Upwards of 100,000 tons of coal, besides lime and pig-iron, are annually shipped from this port, *ib.*

CHARTS OF COAST OF SCOTLAND:—

Inaccuracy of those in general use, Rep. lxi.

COCKENZIE:

This harbour constructed in 1833-4 by Messrs. Cadell for the purpose of shipping coal from their collieries, *Cadell*, 85.—It has an area of 3 acres, and, if required, is capable of great improvement, Rep. xviii.—The entrance is 90 feet wide, and 15 feet deep between the piers, *ib.*—It is easy of access, and may be taken at tide-time in any weather, *ib.*—It is the head-quarters of 35 fishing-boats, *ib.*—The harbour is private property, and permission to land low-duty goods and articles was granted by the Treasury, *Cadell*, 85.—The shore dues amount, on an average of three years, to 35*l.* 13*s.* 4*d.*; average arrivals in the same time, 163, *ib.*—Return of dues levied and arrivals in the years 1841-2-3; the sum expended in keeping the harbour clear exceeds the dues collected, *ib.*—The revenue in 1844 amounted to 38*l.* 19*s.* 3*d.*; in 1845 to 135*l.* 12*s.* 9*d.*; and in 1846 to 50*l.* 8*s.* 1*d.*, Supp. 658.

COLDINGHAM:

Has a small breakwater pier, erected in 1832 by the Fishery Board, with a parapet rising 12 feet above high water, Rep. xx.—This pier is a great boon to the fishermen, *ib.*—It cost 1525*l.*; the entrance is 20 feet wide, *ib.*—It has 20 boats belonging to it, *ib.*

CRAIL:

Present Condition of Harbour:—

This harbour is three-quarters of an acre in extent, enclosed by a south pier and western spur; the entrance is 25 feet wide, Rep. xxvi. Lying within ledges of rock, and having an extensive foreshore

Crail—continued:

Present Condition of Harbour—continued:—

of sand. it is difficult of access, but has depth for a few vessels of 12 feet draft of water, *ib*—The arrivals in 1846 were 65 loaded vessels of 2320 tons, *ib.*

Management:—

Vested, by various charters, in the magistrates and town council of the burgh, *Sim*, 164.

Plans and Surveys:—

The council have no plan of the harbour in their possession, *Sim*, 164.

Income and Expenditure:—

Income.—In 1842, 50*l.* 6*s.*; in 1843, 67*l.* 12*s.*; and in 1844, 72*l.*, *Sim*, 165; for 1845-6, see p. 656.

Expenditure.—In 1842, 94*l.* 16*s.* 3*d.*; in 1843, 19*l.* 19*s.* 1*d.*; and in 1844, 51*l.* 0*s.* 10*d.*, *Sim*, 165.

Reports of Engineers, &c.:—

Leslie, on forming an asylum harbour at Rome, on the eastern part of the town of Crail, 1846, 164.

Complaints:—

None have been received, *Sim*, 163. See Rep. xxvi.

CROMARTY:

This port and its roadsteads the largest and safest, as well as the easiest of access, of any in Great Britain, *M'Donald*, 358.—From 50 to 70 sail frequently take shelter in this bay at one time, from 600 to 800 annually, *ib.*—Defences or fortifications for the protection of the general trade much wanted, which might be erected at a moderate expense, *ib.*—The harbour is formed by two piers and a detached breakwater, built in 1785 at the joint expense of the Government and of the proprietors, Rep. xxxviii.—The arrivals in 1846 were 115 vessels of 7401 tons, exclusive of 600 vessels which took shelter in the roadstead in the same period, Rep. xxxviii.

Income and Expenditure:—

Income—In 1841, 65*l.*; in 1842, 65*l.*; and in 1843, 63*l.*, *M'Donald*, 358; for 1844-5-6, see p. 656.—The dues levied under the authority of the Act of 1834, *M'Donald*, 358.

Expenditure.—In 1841, 14*l.* 15*s.*; in 1842, 15*l.* 18*s*; and in 1843, 25*l.* 17*s.* 10*d.*, *M'Donald*, 358.

CULLEN:

Present Condition of Harbour:—

A small pier harbour liable, on account of its position, to silt up, Rep. xxxv.

Income and Expenditure:—

Income—In 1842, 53*l.*; in 1843, 56*l.* 15*s.*; and in 1844, 61*l.* 11*s.* 8*d.*, *Seafield*, 336; for 1844-5-6, see p. 654.

Expenditure.—In 1842, 4*l.* 15*s.*; in 1843, 35*l.* 8*s.*; and in 1844, 65*l.* 15*s.* 6*d*, *Seafield*, 336.—13,000*l.* have been expended on this harbour by the proprietors, Rep. xxxv.

Customs Duties:—

The customs' duties in 1846 amounted to nearly 2,000,000*l.*, Rep. xvii.—Statement of customs' duties received from the different ports in Scotland in the years 1844, 1845, and 1846, Supp. 654-659.

Debt of Scottish Ports and Harbours:—

Aggregate amount owing by all the Scottish ports, 31 Dec., 1846, 1,535,750*l.*, being eight times the yearly revenue, Rep. xvii.—Statement of the amount of debt due at each port on the 31st Dec., 1844, 1845, and 1846, Supp. 654-659.

DINGWALL:

Communicates with the head of Cromarty Firth by a canal a mile long, having two wharfs with a depth of 13 feet at spring tides, Rep. xxxviii.—It has a fair trade in timber and corn, *ib.*—The revenue in 1846 amounted to 147*l.*, *ib.*

Dredging Machine:—

Suggestions for free use of, Rep. lxii.

DRUMORE:

The bay of Drumore is remarkably easy of access, and sheltered from the prevailing westerly winds, *Guthrie*, 555.—Its situation and capabilities render it particularly suitable for a harbour of refuge, *ib.*—Situation described, *ib.*—The pier was built a few years since for local accommodation, *ib.*—Limited extent of harbour complained of, and only smaller coasting vessels take refuge in it, *ib*—Larger vessels lie daily in the bay, but are frequently compelled to part their cables and run elsewhere for shelter, *ib.*—The works are the property of the Earl of Stair, and persons using them pay small dues, little more than sufficient to keep them in repair, *ib.*—There is no act of Parliament relating to this harbour, *ib.*—Further description of Drumore, Rep. lviii.

Drumore—continued:—

Income and Expenditure:—

Income.—In 1841. 50*l.*; 1842, 50*l.*; and in 1843, 57*l.*, *Semple*, 555: for 1844-5-6, see p. 658.

Expenditure.—In 1841, 17*l.*; 1842, 107*l.*; and in 1843, 137*l.*, *Semple*, 555.

DUMBARTON:

Description of the harbour, Rep. xlvii.

Income and Expenditure:—

Income.—In 1841, 287*l.* 12*s.* 8*d.*; in 1842, 230*l.* 7*s.* 2*d.*; and in 1843, 212*l.* 10*s.* 9*d.*, *Denny*, 384; for 1844-5-6, see p. 658.—The dues are levied under a charter of James VI., ratified by Act of Parliament of 1641, *Denny*, 384.

Expenditure.—In 1841, 564*l.* 15*s.* 10½*d.*; in 1842, 157*l.* 5*s.* 4½*d*; and in 1843, 67*l.* 12*s.* 8*d.*, *Denny*, 384.

DUMFRIES:

Present Condition of Harbour:—

The harbour is formed by the Nith, and extends nearly five miles below the town where the estuary commences, and extends nine miles further to Southerness, Rep. lix.—Within these limits are nine landing-places, *ib.*—At present there are at the several quays 1014 yards of wharfage, of which 230 yards are temporarily unavailable, *ib.*—There is also a small tidal basin at Kingholm, *ib.*—At Southerness the tide rises 26 feet. At Gleneaple Quay there is a depth of 15 feet at high-water springs; at the new quay 10 feet; and at Dumfries, where the navigation and tide are obstructed by a mill-dam weir, 10 feet, *ib.*—Southerness has a good fixed light, *ib.*—The arrivals and sailings in 1846, within the river limits, were 844 loaded vessels of 30,592 tons, *ib.*

Income, Expenditure, and Debt:—

Income.—In 1841-2, 1249*l.* 7*s.* 11*d.*; 1842-3, 1026*l.* 16*s.* 10*d.*; 1843-4, 1212*l.* 3*s.* 7*d.*, *Kneslie*, 613; for 1844-5-6, see p. 654.—The dues levied under 51 Geo. III., *ib.* 613.

Expenditure.—In 1841-2, 1165*l.* 4*s.* 4½*d.*; 1842-3, 847*l.* 9*s.* 8½*d.*; 1843-4, 1248*l.* 11*s.* 7½*d.*, *Kneslie*, 613.

Debt.—Amount due on 1st January, 1846, 5005*l.*, *Kneslie*, 613.

Reports of Engineers, &c.:—

On the state and proposed improvements of the river Nith, 1810, *Hollingsworth*, 598.—On the navigation and improvement of the river Nith from Dumfries to the sea, *Newall*, 1812, 599.—On the state of the Nith in June, 1846, and the improvements made up to December, 1840, *ib.* 603.—On the improvements of the harbour, 1847, *Witham*, 612.

Miscellaneous Papers:—

Answers to printed queries of Tidal Harbours Commissioners, 609.

DUNBAR:

Present Condition of Harbour:—

This port is a valuable fishery station, and from its proximity to the best fishing ground, and the facility of land carriage by railway, is likely to become the chief resort of fishing-boats in this part of Scotland, Rep. xix.—300 boats, 28 of which belong to the port, fish from here in the season, *ib.*—600 boats can lie in the harbour, which is dry at low-water springs, *Sawers*, 89.

The new harbour recently constructed at the joint expense of the Fishery Board and the burgh at a cost of 15,762*l.*, Rep. xix.—It is stated to be very difficult of access, *ib.*—It is adapted only for boats, *Baumback*, 88.—It is 2½ acres in extent, Rep. xix.—Believes there is a depth of at least 12 feet at the entrance of the harbour at low water, *Mason*, 90.—Does not consider the new harbour safe either for vessels or boats until the entrance is widened, *Fender*, 88.—Never brings any vessels into the new harbour, as he considers the entrance too narrow and crooked, *ib.* 88; *Brueman*, 89; *Rich-*

DUNBAR—continued:

Present Condition of Harbour—continued:—

ardson, 89; *Hay*, 89; *Mason*, 90.—It is so narrow that boats cannot use their oars, *Fender*, 89.—The entrance is 70 feet wide, and very difficult of access, Rep. xix.—No vessel can venture alongside the new quay in blowing weather, *ib.*—The foundation is upon rock, the outside and inside walls are of ashlar work, four feet thick each, and packed with large rubble, *Mason*, 90.—It is 46 feet thick at the bottom and 36 feet at the top, 22 feet high, with a parapet of 16 feet; the entrance 50 feet wide at the narrowest, and in some places 60 feet, *ib.*—Admits that the narrowness of the entrance and the projecting rock cause great inconvenience, *ib.*—Has seen many wind-bound vessels at Dunbar, *Fender*, 89.—In westerly gales a great many wind-bound vessels take shelter at Dunbar, *Comb*, 89.—Has seen as many as 40 at one time, *ib.*; *Richardson*, 89.—About 50 vessels pass daily for Leith, *Brueman*, 189.—Has seen 20 wind-bound vessels sail out of the frith in one day, *ib.*—Cargoes of cattle frequently sent from Shetland to Dunbar, *Richardson*, 88.—Five came in last year, and cargoes of corn from the north bound for Leith have often put into Dunbar from stress of weather and been sold there, *ib.*—Six Greenland vessels formerly belonged to the port, *Fender*, 89.

Old Harbour.—The entrance to the old harbour was always dangerous; it is safe when the booms are on it, *Fender*, 88.—Does not consider it more difficult than formerly, *ib.*—Since the booms have been removed, vessels cannot be secured in a gale, *Ramage*, 89.

Management:—

The harbour formerly governed by charter from James VI. in 1618; at present it is governed under an Act of Parliament passed in 1827, *Richardson*, 87-90.—Management of the harbour mixed up with the management of the burgh, but the accounts are kept distinct, *ib.*—The magistrates and council, consisting of 20 members, with a sub-committee of three of their own body, superintend the affairs of the harbour, *ib.* 87.—The Council meets once a month, but oftener if necessary, *Ritchie*, 87.—The accounts are audited by a member of the Committee agreeably to the Act, but they are not published, *ib.*

Income, Expenditure, and Debt:—

Income.—An account, showing the income under different heads in the years 1841 to 1846, both inclusive, *Richardson*, 87. See also Supp., p. 658.

Expenditure.—An account of the expenditure for the old and new harbour in the years 1841 to 1846, both inclusive, *Richardson*, 87.—Average of last three years, 126*l.* 2*s.* 3*d.* *ib.*—The expenditure of the year 1846 increased beyond the usual amount in consequence of a payment of a portion of the expenses of the engineer, *ib.*

Debt.—4,500*l.*, with interest increased to 5,832*l.* 0*s.* 5*d.* *Richardson*, 87.

Shipping and Tonnage:—

About 300 herring boats usually frequent the harbour during season, *Richardson*, 88.—In the year 1845, 323 vessels of 14,427 tons entered inwards, and 61 vessels, tonnage 2,344 outwards with cargoes, *Baumbach*, 88.—The vessels registered at Dundar are 62, 1,291 tonnage, Rep. xix.

Shipwrecks and Lesser Damage:—

Much damage caused by the narrowness of the entrance to the new harbour, *Ritchie*, 88; *Middlemass*, 88; *Comb*, 89.—Has seen much damage done in the old harbour when the wind was from the north-east, *ib.*—93 vessels have been wrecked in 30 years, *Ritchie*, 90.—Vessels have often broken from their moorings, *ib*, 89.—List of wrecks in the vicinity of Dunbar entered in the books of Lloyds, agents, from November 1816 to the present time, *ib*, 96-98.—93 vessels have been wrecked in the last thirty years, *Ritchie*, 90.—Many more wrecks have occurred, insured in other offices, of which no record has been preserved, 96.—Necessity for harbour of refuge evinced by the number of wrecks, Rep. xix.

Improvements Effected:—

The new harbour built at the joint expense of Fishery Board and town of Dunher, *Richardson*, 88-90; Rep. vi.

DUNBAR—continued:

Improvements Suggested:—

Widening the entrance of the new harbour, *Richardson*, 88; *Ritchie*, 88.—Considers the entrance should be made straight, *Comb*, 89.—Opening a communication between the old and new harbour, *Richardson*, 89.—Opening this communication would cost between 500*l.* and 600*l.*, *Mason*, 90.—This formed part of the original plan of improvement, *Ritchie*, 88.—Considers a communication would spoil both harbours, unless gates were put up, *Comb*, 89.—*Richardson*, 89.—Widening the entrance, and opening a communication between the harbours, would be injurious without a jetty, *Sawers*, 88.—The new harbour should be deepened, it being nearly useless at present, *ib.*—A jetty much wanted, *Sawers*, 88; *Richardson*, 88.—It is wanted both for shelter and convenience, *Middlemass*, 88.—Recommends the erection of a quay at the entrance for landing goods and fish, *Mason*, 90: *Ritchie*, 88.—Steam-vessels cannot use the port until a jetty is erected, *Ritchie*, 88.—Cutting away the rock at the entrance would give two fathoms of water there, *Fender*, 88.—Does not recommend money to be laid out upon the old harbour, *Mason*, 90.—A small additional sum spent in deepening the entrance and interior, and in forming a quay by the deep water along the rocks at the entrance, and in effecting a junction between the old and new harbours would be a great benefit, Rep. vi.—Without this is done the expenditure already incurred will, in a great measure, be lost, *ib.*—Anxiously desires the expenditure to be laid out upon the entrance of the new harbour, where there is a fine bottom and deep water, and protection from the heaviest seas, *ib.*

Harbour of Refuge.—Considers Dunbar the best place on the coast for a harbour of refuge on a large scale, *Earl of Haddington*, 88.—Is of opinion that a harbour of refuge could be advantageously made, and would be of great benefit to the shipping interest, as vessels in a gale could then enter the harbour, which now are compelled to run up the Frith, *Fender*, 89.—Has often known vessels lost here, from there being no harbour of refuge, *ib.*—A harbour of refuge would be useful both to northward and southward bound vessels, *ib.*; *Comb*, 89.—Nine vessels were wrecked in one year between Dunbar and St. Abb's Head, all of which might have been saved if there had been a harbour of refuge, *ib.*; *Richardson*, 89.—Neither Eyemouth nor North Berwick so favourably situated for a harbour of refuge as Dunbar, *Comb*, 89; *Richardson*, 89.—One at Dunbar particularly convenient for Queen's vessels, *ib.*; *Hay*, 89.—Many lives, and much property would be saved by its erection. Has seen ten vessels wrecked in one day, all of which might have been saved if there had been a harbour of refuge, *ib.*; *Brueman*, 89.—The area of the proposed harbour of refuge would be 50 acres, and it would cost 300,000*l.*, *Mason*, 90.—The position of Dunbar in the track of the numerous shipping which trade along the coast, and the numerous wrecks which have occurred, are strong points in its favour for a harbour of refuge, Rep. xix.

Complaints:—

The narrowness of the entrance of the new harbour generally complained of, *Richardson*, 88; *Baumbach*, 88; *Fender*, 88, 89; *Brueman*, 89; *Richardson*, 89; *Hay*, 89, *Mason*, 90.—The quays of the new harbour are too high for the trade of the port, *Baumbach*, 88.

Reports of Engineers, &c.:—

Smeaton on the harbour, 1772, 91.—Mitchell, on the new harbour, 1841, 92, 93.—Walker, on the sufficiency of the works, 1843, 93.—Vetch, on forming a harbour of refuge at Dunbar, 1847, Supplement, 653.

Miscellaneous Papers:—

Return of magistrates to House of Commons relative to the harbour, 1844, 90, 91.—The Secretary of the Admiralty to the Provost of Dunbar, in reply to a request that the harbour may be surveyed by a Government engineer, 1842, 93.—Extract from the Acts of Convention of Royal Burghs, 1844, 94.—Petition of General Convention of Royal Burghs to the Lords of the Treasury, 1844, 94.—Memorial of Dunbar Harbour Committee to the Tidal Harbour Commission relative to harbouef refuge, 1845, 95.

DUNDEE:

Present Condition of Harbour:—

There has been no material change in the sandbanks, *Leslie*, 195; *Jack*, 197.—The estuary requires constant watching, *ib.* 195—The banks are always altering, *Kidd*, 198.—There is a tendency to silt up in the harbour, which is kept down by dredging and scouring, *Leslie*, 195; *Jack*, 197.—The ballast bank for the last four or five years has been turning outwards, *Leslie*, 195.—It is further from the harbour than it was some years since, but it is not extending; it is not so bad as it was in 1845, *ib.*; *Kennedy*, 195.—It has grown five or six times as large as it was a few years since; instead of a narrow bank, it is now a complete field of sand, *Neish*, 195.—The bank is going off there very fast, *Jack*, 197.—The embankment of the Dundee and Arbroath Railway has proved injurious, from its being partly formed of loose stuff thrown down below high-water mark, *Leslie*, 195.—There is no want of harbour accommodation at Dundee, *ib.*—Any repairs can be made to steamers and other vessels, *Jack*, 197.—There are numerous cranes, and an excellent working 30-ton crane, *ib.*—There are 13 building slips, one graving dock, one patent slip, and two floating docks, *ib.*—The trade of the port has increased with the increased accommodation, *Leslie*, 195.—There are plenty of shipyards in the town, which are fully employed, *Jack*, 197.

Encroachments.—Encroachments have been made on the river, by running out dykes from Powgavie upwards, to make land, *Leslie*, 195.—The effect is injurious to the scour, *ib.*—One of these dykes extends to 1000 yards below high water, Rep. xxviii.—These projects, if allowed to be completed, will include 1800 acres of the alveus of the river over which the tide flows, *ib.*—The Dundee and Perth Railway, although it has displaced water, has not proved injurious, as it has increased the scour, *ib.*

Pilotage.—Pilots are examined by the Trinity Board, and are licensed by trustees, on certificate of fitness, *Milne*, 194.—Pilotage not compulsory, *ib.*; *Jack*, 197.—Qualification of some of the pilots objected to, *Irwin*, 99.—The want of pilots occasions many accidents, *Jack*, 197.—Pilots, on an inspection of their boats about 12 months since, had neither leads nor lines, *ib.* 198.—Vessels seldom boarded by pilots in stormy weather, *Irwin*, 199.—Pilots usually board vessels at about Broughty Ferry, *ib.*—Has 28 pilots under his orders, *Webster*, 199.—Frequent complaints have been made to witness of the pilots, *ib.*—No inducement to pilots to go outside, as they are only paid harbour pilotage, *Kerr*, 200.—Life-boat stated to be heavy, and a bad sea-boat, and that there was a difficulty in getting it manned, *Irwin*, 200.

Lights, Buoys, and Beacons.—The lights are under the management of the Trinity Board, *Milne*, 194; *Kennedy*, 199.—The Seaman's Fraternity raise 1800*l.* for the lights, and expend for this service only 700*l.*, *Hunter*, 197.—Considers it illegal to expend light money for any other purposes than those for which it is professedly raised, *ib.*—Return of light dues levied in 1843 and 1844, 242.—The Tay is well buoyed; the fairway buoy at the entrance is 15 feet above water, and can be seen at 10 miles distance, *Jack*, 197; *Craighton*, 198.—The complete state of the buoying of the entrance of the Tay is very creditable to the Seaman's Fraternity Society, under whose management it is placed, Rep. xxviii.—Extract from Stevenson's Report on the lights of the Tay, 198.—The income of the Trinity Board in 1845 was 1842*l.* 12*s.* 6*d.*, and the expenditure for buoys and beacons, 1085*l.* 13*s.* 1*d.*; the rest expended in pensions to widows, &c., *Kennedy*, 200.

Obstructions.—The Beacon and Fowler rocks the greatest impediments to the shipping in entering the harbour, *Creighton*, 196.—It is frequently difficult to take the harbour in consequence of these rocks, *Jack*, 197.—Ships often damaged by these rocks, *ib.* 196; *Clark*, 196.—Ships are often damaged in the harbour from the effect of the rocks, *ib.*—Considerable damage sometimes done in the harbour from the press of sail coming in; this partly caused by the rocks, *Jack*, 197.—[These rocks not only cause damage to shipping, but also cause deposit of silt in the harbour, *Tidal Harbours Commissioner*, 201], Rep. xxviii.

DUNDEE—continued:

Management:—

The management of the harbour previous to 1815 vested by charter of 1641 in the magistrates and council, *Milne*, 194.—Several Acts have since been passed, giving power to Commissioners to raise money for improvements, *ib.*—The Board consists of 21 trustees, viz., 6 from the town council, 6 from the guildry, 3 from the nine incorporated trades, 1 from the three trades, 1 from the Trinity House, and 4 from the county, *ib.*—The provost and magistrates are trustees *ex-officio*, all the others are elected annually, *ib.*—Three of the trustees at present are sailors, *ib.*—Seven form a quorum; there is no difficulty in getting the proper number together, *ib.*—Statement in detail of the several Acts under which the harbour has been governed at different times, 201.—[The Commissioner having inspected the minute books, &c., admitted that they were satisfactorily kept, 194].—The auditor is appointed by the sheriff, and is entirely unconnected with the trustees, *Carncoss*, 195.

Income, Expenditure, and Debt:—

Income.—In the year 1841-2 the income amounted to 18,443*l.* 0*s.* 7*d.*, in 1842-3 to 17,381*l.* 0*s.* 10*d.*; and in 1843-4 to 23,908*l.* 2*s.* 9*d.*, 242.—Average of three years, ending 1844, 19,894*l.* 8*s.*, *ib.*; for 1844-5-6, see p. 656.

Expenditure.—The expenditure in 1841-2 amounted to 20,224*l.* 17*s.*; in 1842-3 to 19,978*l.* 17*s.*; and in 1843-4 to 26,638*l.* 2*s.* 2*d.*, 242.—Average expenditure of three years, ending 1844, 22,280*l.* 12*s.* 6½*d.*, *ib.*

Debt.—A sinking fund, brought into operation under the last Improvement Act, providing for the gradual extinction of the debt, *Milne*, 194.—17,411*l.* has already been paid off, *ib.*—50,000*l.* was borrowed at 3½ per cent., the remainder at 4 per cent. interest, *ib.*—The debt due on 1st of January, 1846, amounted to 224,150*l.*, 242.—By the Act 6 and 7 Vic., c. 83, 5750*l.* is required to be paid off the debt yearly, *ib.*

Shipping and Tonnage:—

Arrivals in 1845-6, 4314, *Jack*, 197.—The arrivals and sailings in 1846 were 4805 loaded vessels, of 392,363 tons, of which 663 vessels were either colonial or foreign, Rep. xxix.—The trade of the port has increased considerably with the increased accommodation, *Leslie*, 195; *Jack*, 197.

Shipwrecks and Lesser Damage:—

List of wrecks at the entrance of the river Tay, from 1825 to 1845, 243.

Improvements Generally:—

Deepening the channel below Perth did not carry up more tidal water, *Leslie*, 195.—A bell-buoy would be useful in hazy weather, *Irwin*, 199; *Kidd*, 199.—It could not be heard half a mile off in a gale, *Kidd*, 199.—Would be of very little use, *Webster*, 199.—[Recommends the purchase of a life-boat, built by Bremner, of Wick, which moves by paddles wrought by a crank, and said to do more work than can be done by any oars, *Tidal Harbours Commissioner*, 200.]

Improvements Effected and in Progress:—

Under the new management, great and judicious improvements have been effected, Rep. xxviii.—The space between high and low water mark, from Carolina Port on the east, to Craig Pier on the west, has been enclosed by a river wall, *ib.*—Two wet docks, containing an area of 11½ acres, capable of containing 23,000 tons of shipping, have been completed, *ib.*—Another wet dock of 14½ acres, opening from a tidal harbour of 11 acres, is far advanced towards completion, *ib.*—400,000*l.* have been expended on their improvement, *ib.* (vide *Debt*).—The erection of the wooden pier, by increasing the accommodation, has increased the quantity of goods and cattle imported, *Robertson*, 196.

Improvements Suggested:—

Floating Light.—The erection of a floating light under consideration at present, in consequence of the number of accidents at the mouth of the river, *Milne*, 194.—The suggestions as to the floating light have all been made verbally, *Brown*, 194.—Captain Greig, of the "Britannia," has strongly urged its erection, *ib.*—Necessity for floating light urged in consequence of the circum-

DUNDEE—continued:

Improvements Suggested—continued:—

stances attending the wreck of a schooner on the Abertay Sands, *Hunter*, 196.—Believes a floating light would be of great service to the navigation, *ib.*—A floating light cannot be placed without imposing new dues; it would cost about 1200*l.*, *Kennedy*, 198; *Stevenson*, 198.—Does not consider a floating light necessary, *Jack*, 197; *Crighton*, 198.—It would be more likely to lead vessels into danger, *Spink*, 199; *Irwin*, 199; *Kidd*, 199; *Webster*, 199.

Removal of Obstructions.—The removal of the Beacon Rocks to low-water mark very desirable, *Leslie*, 195; Rep. xxviii.—They could not be removed but at a great expense, *Leslie*, 195.—If removed, they must be brought down to the level of the west dock, or they would be better as they are, *ib.*—The Beacon and Fowler Rocks should both be cut away, *Crighton*, 196, 200; *Clark*, 196; *Neith*, 196; *Jack*, 197.—[The rocks at the entrance of the harbour are a perfect nuisance, and should be quarried or blasted away at any cost, *Tidal Harbours Commissioner*, 200.]—Cutting away the Horse-shoe Shoal at Broughty Ferry to low water would be of great advantage, *ib.*

Pier at Broughty Ferry.—Landing place at Broughty much desired by the owners of bleachfields and others in the neighbourhood, *Norrie*, 195, *Spence*, 195.—With proper accommodation, Broughty might be made fit for shipping agricultural produce, *ib.*—Is strongly opposed to any encroachments on the river at this place, *Ower*, 195.—Broughty a bad place for a ferry pier, *Leslie*, 195.—Any encroachments at this place would be dangerous to the navigation, *ib.*

Pilotage.—A pilot cutter, to enable the pilots to go outside in all weathers, would lessen the number of accidents, *Jack*, 197; *Irwin*, 199.—Pilotage should be compulsory, *Jack*, 197; *Spink*, 199; *Irwin*, 199; *Kennedy*, 200.—If made compulsory on all vessels of 100 tons and upwards, and on all foreign vessels, the dues would be sufficient to remunerate the pilots and leave a surplus of 100*l.* a-year, *Kennedy*, 200.

Chain Bridge to the Beacon Rock.—To remedy the want of a low-water pier, recommends the erection of a chain bridge from the land to the Beacon Rock, *Allardice*, 196.—Chain bridge to the Beacon objected to by many persons, as it would shut up the passage for vessels inside the rock, 196.—Objects to the chain bridge; its erection would make it necessary for vessels going out, as they often did in half ballast, from one dock to another, to go out into the middle of the river, which would be very dangerous, *Crighton*, 196.—Is of opinion that a low-water pier to the Beacon would prove a great obstruction to the harbour, and cause great inconvenience, *Neish*, 196; *Jack*, 197.—The want of a low-water pier much felt, Rep. xxviii.

Complaints:—

All complaints are immediately attended to, *Milne*, 194.—Copies of complaints by trustees of encroachments on the harbour, 202.—The inhabitants of Broughty complain of being compelled to pay the same shore dues as at Dundee, Rep. xxix.

Reports of Engineers, &c.:—

Smeaton, 1770, 262; *Stevenson*, 1814, 203; *Telford*, 207; *Jardine*, 1830, 209; *Gibb*, 1831, 210; *Gibb*, 1832, 211; *Leslie*, 1838, 213.—Leslie, on complaint of want of low-water pier at Dundee, 1845, 228.—Leslie, on the same, with estimate, 1845, 234.—Leslie, on the proposed jetty at Broughty Ferry, 1835, 213.—Leslie, on the encroachments on the Tay by Lord Kinnaird and Colonel Paterson, 1843, 219.—Statement for Counsel, 220.—Blackadder, on the effects of the encroachments at Powgavie on the scour at Dundee, 1844, 222.—Leslie, on a dike and cairn below the South Ferry, 1844, 222.—Washington, on the Tay Navigation, 1844, 226.—Walker, on embanking the shore or bed of the Tay, 1845, 229.—Stevenson, on the proposed Floating Light at the entrance to the Firth of Tay, 1845, 236.

Miscellaneous Papers:—

Return to an Order of the House of Commons of August, 1844, 201.—Queries and opinion of Council as to the limits of jurisdiction of the harbour trustees, 224.—Complaint of want of low-water pier at Dundee, *Kennedy*, 1844, 228.—Minutes of Committee thereon, 229.—Jardine, on the case of the Dundee Harbour Trustees, *v.* David Hunter, Esq. of Broughty Ferry, 236.—Paper, on the case of Lindsay *v.* the Harbour Trustees of Dundee, 241.—Complaints of inhabitants of Broughty Ferry and neighbourhood relative to the heavy shore dues, enacted by the trustees of Dundee harbour, and as to the want of proper landings, 1846, 237.—Complaints of the Edinburgh and Dundee Steam Packet Company, on the high charges for harbour and light dues in the Tay, 1846, 238, 239.—On the want of defences at Broughty Ferry for the protection of shipping, 1846, 237.—Allardice, on the want of a low-water pier and improved ferry, 1847, 239, 240.—Petition of merchants, shipowners, &c., of Dundee to the House of Commons on the harbour, 241.—Return of charges for pilotage and Tay lights in 1843 and 1844, 242.—Return of light dues paid for Tay lights in 1843 and 1844, 242.—Return of income and expenditure in 1841, 1842, 1843, and 1844, 242.—List of wrecks at the entrance of the Tay from 1825 to 1845, 243.

DUNGLASS:

A small fishing harbour, erected in 1831 by the Fishery Board, Rep. xx.—The entrance is 72 feet wide, *ib.*—It has seven boats belonging to it, *ib.*

DYSART:

Present Condition of Harbour:—

Has an area of three acres, sheltered by piers, with an entrance 67 feet wide and 16 feet deep, Rep. xxiv.—About 100 feet of the point of the east pier thrown down by a storm in November, 1844, 159.—The navigation considerably impeded by this damage, *ib.*—Plans for repairing the pier now under consideration, *ib.*—Its restoration will be delayed, on account of the low state of the finances of the burgh, *ib.*—It has just been rebuilt (1846), but in a wrong direction, Rep. xxiv.—The arrivals in 1845-6 were 152 sailing vessels of 5085 tons, exclusive of 900 calls from steamers, *ib.*

Management:—

The 26th of Geo. II., and the 43rd of Geo. III., the Acts regulating the burgh, *Justice*, 159.

Income and Expenditure:—

Income.—In 1841-2, 347*l.* 19*s.* 9*d.*; in 1842-3, 435*l.* 16*s.* 3½*d.*; and in 1843-4, 339*l.* 16*s*, *Justice*, 159.

Expenditure.—In 1841-2, 210*l.* 3*s.* 10½*d.*; in 1842-3, 161*l.* 4*s.* 9*d.*; and in 1843-4, 147*l.* 4*s.*, 159.

Reports of Engineers, &c.:—

Leslie, on the works necessary for the security and improvement of the harbour, 1838, 159.

EARN RIVER:

Is navigable for small craft up to Earn Bridge, six miles from the Tay, Rep. xxvii.—If considered necessary, it could be made navigable without much difficulty into the valley of Strathearn, *ib.*

EAST TARBERT:

The 6th of Ann for erecting a harbour or quay the Act under which the works have been carried on, *Campbell*, 379.—Considerable improvements have been made at the joint expense of witness and of the Commissioners of Highland Roads and Bridges, *ib.*—An additional quay for the accommodation of steam boats has recently been erected, *ib.*

Income and Expenditure:—

Income.—In 1841-2, 104*l.* 18*s.* 11½*d.*; in 1842-3, 113*l.* 7*s.* 4½*d.*; and in 1843-4, 127*l.* 10*s.* 8*d.*, *Campbell*, 380.

Expenditure.—In 1841-2, 129*l.* 10*s.* 10*d.*; in 1842-3, 121*l.* 18*s.* 11½*d.*; and in 1843-4, 26*l.*, *Campbell*, 380.

EDEN RIVER:

This river, with little difficulty, might be made navigable for some distance towards Cupar, which is nine miles from the sea, Rep. xxvi.—The tide rises 15 feet on the coast, reaches Lydon Mill, three miles above Guard Bridge, where it is stopped by a weir across the river, *ib.*—Guard Bridge is a fixed bridge across the mouth of the Eden, *ib.*—Below

EDEN RIVER—continued:—

the brige is a quay, at which timber and coals are landed for the neighbouring district, *ib.*

ELIE:

Present Condition of Harbour:—

This place considered, after Burntisland, the best harbour in the Firth of Forth, and the one most often taken by shipping, Rep. xxv.—From its naturally sheltered position it is a secure harbour in easterly gales; it has often afforded refuge to fishing-boats in distress, *ib.*—The small pier, 70 feet of which were washed down by the sea some years since, has recently been repaired, *ib.*—It remained a long time in ruins from the difficulty of raising sufficient funds for its restoration, *ib.*—The arrivals and sailings in cargo in 1846 were 168 vessels of 6903 tons, *ib.*—The income in 1844 amounted to 37*l.* 19*s.* 2*d.*, 1845, 33*l.* 9*s.*, 1846, 36*l.* 15*s.* 9*d.*, Supp 656.

The Vows.—Dangerous half-tide rocks immediately off shore to the westward, and right in the track of the numerous steamers calling at Elie in the summer, and of vessels running for shelter, Rep. xxv.—These rocks are without a beacon to mark them, *ib.*—The Commissioners of Northern Lights have been memorialized on this subject, but no reply has been received, *ib.*—Evidence as to wrecks of ships, fishing-boats, &c., on these rocks, showing the necessity for placing a beacon upon them, *ib.*—A beacon is now in course of erection, Note to Rep. xxv.

Improvements suggested:—

A landing-place for steamers is much wanted, Rep. xxv.—This might be made at a moderate expense, by adopting the peninsular rocky point, which projects at the south-eastern point of the bay, *ib.*—This would make a good landing on either side, according to the state of the tide, *ib.*; *Stevenson*, 160.—Raising the sea-wall or dyke connecting the pier with the town necessary to prevent the harbour from being filled with sand from Wade's Bay, Rep. xxv.—Stevenson's report and estimate on forming a harbour of refuge at Elie, 1836, 160.—Opinions of master mariners on the same, 1838, 162, 163.

Complaints:—

That this excellent natural harbour, which at a small expense might be made of great value to sailors and to the public, is suffered to remain comparatively useless from the indifference or neglect of those whose duty and interest it is to look after it and keep it in repair, Rep. xxv.—That sunken vessels are allowed to remain in the fairway, and no attempts made to raise and remove them, *ib.*—Particulars of vessels so left, and the injury to fishermen and others in consequence, *ib.*—If this duty does not devolve upon the Commissioners of Northern Lights, the safety of vessels and of sailors' lives demands that some proper authority to remove such obstruction should be constituted, *ib.*

EMBANKMENTS:—

Kincardine, Rep. xxiii.—River Tay, Powgavie, &c., *ib.* xxviii.—Montrose, the Slake, *ib.* xxxi.

EYEMOUTH:

Present Condition of Harbour:—

This harbour is formed by the outlet of a mountain stream falling into a small bay, sheltered by the Hurcar Rocks, which extend as a natural breakwater across its entrance, leaving a passage on either side, Rep. xix.—The entrance is 154 feet wide and 14 feet deep at high-water springs, *ib.*—A stone pier (one of Smeaton's earliest designs), carried out from the eastern shore, protects the harbour, *ib.*—A quay wall, rebuilt in 1843, down the middle of the river, forms an upper basin, and shelters the vessels from the freshes, *ib.*—The harbour is safe when once inside, *Craig*, 101.—The bar is of sand and shingle, over rock, and varies in height as much as 1 or 2 feet, *ib.*—The average rise of spring tides is 14 feet of equinoctial springs; 16 feet neaps rise to 10 feet, *Whillis*, 101.—The river wall along the ballast quay is much out of repair; it has fallen into the river in many places, *ib.*—The stream flows 200 yards above the bridge, *ib.*—A pier head light formerly shown during the fishing season, but has been discontinued during the last two years, because the fishermen refuse to pay for it, *ib.*—[The Examining Commissioner observed that the discontinuance of the light was much to be regretted, as the want of it might cause the destruction of a boat's crew, and desired to call the serious consideration of the trustees to this subject, that as gas was laid down on the quays, 5*l.* would probably cover the expense of an additional burner, 101].—Eyemouth is an important fishing station as well as a refuge harbour for wind-bound vessels, *Bowhill*, 100.—It is the head quarters of an important fishery, extending 30 miles along the coast, and employing 166 boats and 823 men and boys, Rep. xix.—The population is about 1400, of which 110 are fishermen, *Ferme*, 100; Supp. 624.—The chief exports are grain, herrings, &c., and the imports, coal, timber, salt, &c., *Gillie*, 100.—The arrivals in 1845-6 were 305 vessels of 13,067 tons, Rep. xix.—A deposit of about one foot a-year takes place in the basin, to remove which a sluice was formed, but has since got out of order and been closed up, *Whillis*, 101.—Ballast is charged 7*d.* a-ton, *ib.* 101; *Craig*, 101.—Quality of ballast supplied objected to, *Whillis*, 101, *Craig*, 101.

Pilotage.—There are 20 pilots who receive license from trustees on producing certificates of good character, but do not undergo any examination, *Craig*, 101.

Management:—

The governing Act is 2 Vic. cap. 30, which repealed 37 Geo. III. cap. 49, *Calder*, 100.—Prior to 1791 there was no separate trust, *ib.*—Twenty-five trustees named in the Act, this number reduced by deaths, &c., to eleven, *ib.*—Trustees meet quarterly, three form a quorum, and great difficulty is felt in getting this number together, *ib.*—The meetings are not public, *Bowhill*, 100.—The accounts are audited annually by the chairman of the meeting, *ib.*—Treasurer and collector both give security, *ib.* [The account books examined by Tidal Harbours Commissioner, who pronounced them to be properly kept, 100.]

Income, Expenditure, and Debt:—

Income.—In 1834 the income amounted to 94*l.* 17*s.* 5*d.*; in 1846 to 281*l.* 17*s.* 10*d.*, *Bowhill*, 100,—It has considerably increased within the last three years, *Ferme*, 100.—In 1845 the revenue amounted to 498*l.* 5*s.* 1*d.*, *ib.*—This increase caused by the arrival of the materials for the construction of the North British Railway, *ib.*—Statement of income in 1841, 1842, and 1843, 114.—Account of the receipts in each of the years from 1837 to 1846, Supp. 625; see also p. 661.—The dues are much lower than at any of the neighbouring ports, *Gillie*, 100.—A great portion of the revenue is derived from dues on wind-bound vessels, *ib.*—The dues are levied under the Act of 1839, Rep. xix.

Expenditure.—Amount expended in 1841, 1117*l.* 13*s.* 5*d.* (including 1000*l.* for building jetty, &c.); in 1842, 177*l.* 7*s.* 8¾*d.*; and in 1843, 136*l.* 15*s.* 9¼*d.*, 114.—The cost of obtaining the Improvement Act of 1839 amounted to 460*l.* 19*s.* 9*d.*, or nearly two years' income, *Bowhill*, 100.—Account of the expenditure in each year from 1837 to 1846, distinguishing the amount paid for deepening the harbour from the general expenditure, Supp 625.

Debt.—The debt amounts to 2000*l.*, for which interest at the rate of 4 per cent. is paid, which will shortly be raised to 5 per cent., *Bowhill*, 100, 114.—The debt incurred in 1843 and subsequently by removing the old and building new jetty, and partly by the expense of deepening the harbour, *ib.*, 100.

Shipping and Tonnage:—

340 vessels entered the harbour in 1846, *Bowhill*, 100.—The arrivals in 1846 were 30 foreign vessels, of 2047 tons, and 275 coasters, of 11,020 tons, *Gillie*, 100, Rep. vii.—Has seen 14 large fishing-boats, and 40 herring, carrying from six to seven men each, sail from Eyemouth in the season, *Whillis*, 101.—Has also seen 26 French fishing vessels and 40 coasters at one time in the harbour, *ib.*—Account of number of boats and fishermen on Eyemouth station, 111, Rep. vii.

Shipwrecks and Lesser Damage:—

Seven vessels were wrecked in 1838, and several lives lost, within four miles of Eyemouth, *Ferme*, EYEMOUTH—continued:

Shipwrecks and Lesser Damage—continued:—

100; *Dalyell*, 100.—List of shipwrecks near Eyemouth, from 1816 to 1846, 96.

Improvements Effected:—

A new jetty has been built, to form a sheltered basin for vessels to lie in clear of the freshes, *Bowhill*, 100; *Whillis*, 101.—The harbour has been deepened at an expense of 522*l.*, *Bowhill*, 100; *Whillis*, 101. It has been deepened about a foot, *Craig*, 101.

Improvements Suggested:—

General deepening of the harbour the most desirable improvement, *Whillis*, 101; *Craig*, 101; *Hudson*, 101; *Hay*, 101.—It should be deepened to 12 feet at the bar at neap tides, *Hudson*, 101; Rep. xix.—This would be attended with considerable difficulty, as rocky skares of whinstone cross it in many places, *Whillis*, 101.—The removal of the skare at the pier-head, which dams up the water, much desired, *Craig*, 101.—If the skares cannot be removed by dredging, they should be removed by blasting, *ib.*—Enclosure of the bay by a breakwater, to form a harbour of refuge, generally desired, *Bowhill*, 100; *Ferme*, 100; *Dalyell*, 100; *Craig*, 101; *Whillis*, 101; *Hudson*, 101.—Eyemouth a good site for such a work, *Bowhill*, 100.—Opinions of naval officers in favour of this site, *Bowhill*, 100; *Dalyell*, 100.—Its advantages stated, Rep. xix.—The admiralty survey of 1839 has shown detached rocks starting up in various directions, which, if the proposed breakwaters are constructed, will limit the space so much that there would not be room for a dozen loaded vessels to lie afloat, *ib.*—Plans have been made and estimates taken, showing its practicability, at a cost of only 50,000*l.*, *Dalyell*, 100.—There is no harbour of refuge accessible at all time from the Humber to the Firth of Forth, a distance of 200 miles, *ib.*—Necessity for harbour of refuge shown by the number of wrecks which have occurred in the vicinity, *Hudson*, 101; *Ferme*, 100; *Craig*, 101; *Whillis*, 101.—The removal of the inner Buss by blasting recommended, *Whillis*, 101; *Craig*, 101.—This a dangerous rock, with only six feet of water over it at low tide, and should be blasted away, *Craig*, 101, Rep. xix.

Lights, Buoys, and Beacons.—Leading lights are wanted as a guide into the harbour, *Hudson*, 101.—One a fixed light, the other a tidal light, to be shown as soon as there are ten feet of water over the bar, *Hudson*, 101; *Hay*, 101.—A beacon to be placed on the Buss, off Luff-Hard, *Whillis*, 101; Rep. xix.—A warping booy off the harbour's mouth would be found very useful, *Whillis*, 101.

Complaints:—

The dilapidated state of the old pier and river wall; want of crane, and warping buoy off the harbour's mouth; want of beaching plan; light at pier head and beacon on the Inner Buss, Rep. xix.

Reports of Engineers, &c.:—

Smeaton, on Eyemouth harbour, 1767, 102.—Jardine, 1837, on the same, 103.—Mitchell, on the proposed improvements, 1840, 104.

Miscellaneous Papers:—

Return to an Order of the House of Commons relative to Eyemouth harbour, 102.—Statement of 30 ship-masters, &c., relative to Eyemouth, 103.—Memorandum by Sir D. Milne on the harbour, 103.—Letter from secretary of National Floating Breakwater and Refuge Harbour Company, 106.—Memorials of merchants, shipowners, &c., relative to harbour of refuge, 107-109.—Statement of capabilities of Eyemouth for harbour of refuge, 112.—Account of number of boats and fishermen on Eyemouth station, 111; Supp., 624.—Return of income and expenditure in 1841-1843, 114.

FERRY-PORT-ON-CRAIG:

Description of the Port,—Rep. xxvii.

Income and Expenditure:—

Income.—In 1841, 31*l.* 6*s.* 8*d.*; in 1842, 33*l.* 0*s.* 5*d.*; and in 1844, 42*l.* 18*s.*, *Dangall*, 170; for 1845-6, see p. 656.—The dues are levied under authority of a royal charter, *Dangall*, 170.

Expenditure.—The expenditure for repairs was very trifling in the years 1841-2 and 1843, *Dangall*, 170.

Miscellaneous Papers:—

Admiralty Report of the Edinburgh and Northern

FERRY-PORT-ON-CRAIG—continued:

Miscellaneous Papers—continued:—

Railway Improvement of the Ferry between Ferry-Port-on-Craig and the north bank of the Tay, 170-1.

FINDHORN:

Present Condition of Harbour:—

Has two good piers, and vessels drawing 12 feet of water can reach them in fine weather, Rep. xxxvi.—It has a shifting bar with 14 feet over it at high-water springs, but unsafe in north-east gales, *ib.*—The arrivals in 1846 were 214 vessels of 13,600 tons, *ib.*

Income and Expenditure:—

Income.—In 1842, 200*l.*; in 1843, 200*l.*; and in 1844, 200*l.*, *Brown*, 339; for 1845-6, see p. 656.—The dues are levied under an Act passed in 1777, *Brown*, 339.

Expenditure.—In 1842, 3*l.* 1*s.* 10*d.*; 1843, *nil*; and in 1844, 25*l.*, *Brown*, 339.

FISHERIES:—

Extent of.—The Scottish fisheries, in their present imperfectly developed state, and cramped by want of sheltered harbours, &c., employ 10,535 boats, manned by 40,758 men and boys, exclusive of 32,270 tons of shipping occupied in the carrying trade in connexion with the fishery, Rep. xvii.—Number of boats, decked and undecked, employed in the shore curing herring, cod, and ling fisheries, and the number of fishermen and boys employed at the several fishing districts in Scotland, in the year ending January, 1847, Supp. 661-668.

FISHERROW:

Present condition of Harbour:—

The harbour of Musselburgh has an area of about two acres, enclosed by stone piers, one of which has recently been rebuilt, Rep. xviii.—68 fishing-boats belong to the port, employing 340 men and boys, *ib.*

Management:—

This port included within the burgh of Musselburgh, *Lees*, 84.—It is under the management of the magistrates and Town Council of the burgh, who are Commissioners under the Act 3 Vic., cap. 73, the governing Act, *ib.* 84.

Income, Expenditure, and Debt:—

Income—Arising from tonnage, planking shore-boat, and ballast dues and interest, amounted in 1842 to 362*l.* 13*s.* 2½*d.*; in 1843, to 291*l.* 1*s.* 2½*d.*; and in 1844, to 361*l.* 11*s.*, *Wilson*, 84; for 1845-6, see p. 658.—Levied under the Act 3 Vic., cap. 73, Rep. xviii.

Expenditure—Amounted in 1842 to 326*l.* 15*s.* 10*d.*; in 1843 to 357*l.* 2*s.* 11½*d.*; and in 1843 to 2020*l.* 19*s.* 2½*d.*, *Wilson*, 84.—The large expenditure in 1843 was caused by a sum of 1655*l.* 2*s.* 5*d.*, incurred for building a new pier, *ib.*

Debt—Amounted on 1st January, 1846, to 7218*l.*, *Wilson*, 84.

Shipping and Tonnage:—

The arrivals in 1846 were 457 vessels of 20,027 tons, Rep. xviii.

Reports of Engineers:—

Stevenson, on improvement of Fisherrow, 1839, 84.

FORTH AND CLYDE NAVIGATION:

This canal affords a navigable channel between the east and west coasts of Scotland for vessels not exceeding 8½ feet draft of water, Rep. xxi.—Description of the canal, length, number of locks, &c., *ib.*—The cost of the entire work amounted to 330,000*l.*, *ib.* xxii.—The affairs of the Company stated to be judiciously managed, *ib.*—The tonnage dues have recently been reduced, *ib.*—The Monkland Canal 12 miles in length, recently incorporated with the Forth and Clyde Navigation, *ib.*—The total cost of both canals up to the present time amounts to 1,090,380*l.*, *ib.*

Income, Expenditure, and Debt:—

Income.—In 1841, 80,940*l.* 9*s.* 7*d.*; 1842, 75,117*l.* 5*s.* 3*d.*; 1843, 63,516*l.* 10*s.* 6*d.*, *Crichton*, 487.—The dues are levied under the authority of the Act 4 & 5 Vic. c. 55, *ib.*—The highest revenue was received in 1839, when it amounted to 95,475*l.*, Rep. xxii.—The income in 1846, including that of the Monkland Canal, amounted to 115,621*l.*, *ib.*

Expenditure.—In 1841, 26,142*l.* 14*s.* 11*d.*; 1842, FORTH AND CLYDE NAVIGATION—continued:

Income, Expenditure, and Debt—continued:—

68,635*l.* 1*s.* 4*d.*; 1843, 43,298*l.* 8*s.* 11*d.*, *Crichton*, 487.

Debt.—36,489*l.* 18*s.* 4*d.*, due on the 31st December, 1843, *Crichton*, 487.—171,350*l.* due in 1846, Rep. xxii.

FORTH, FIRTH OF:

The Firth of Forth the most capacious inlet of the sea on the eastern coast of Great Britain, valuable for its large amount of traffic, and as affording the only real refuge in an easterly gale on this part of the coast, Rep. xx.—It is navigable at all times for vessels of 12 feet draft as far as Grangemouth and Kincardine, and, at tide time, to Alloa and Stirling, for a distance of 54 miles, *ib.*—In this space are included 40 piers and tidal harbours, and the roadsteads of Leith, Aberlady, and Elie Bays, and the sheltered anchorage of St. Margaret's Hope, *ib.*—18,136 vessels of 1,532,603 tons, paid dues in 1846 for the Inch Keith Light, *ib.*—Account of damage done westward of Leith, and under Leith Fort by the inroads of the sea upon the shore, *ib.* xxi.—The practice of shipmasters throwing ballast into the Forth on their passage from Queen's Ferry up to Alloa and Stirling generally complained of, *ib.* xxii. —This practice has considerably increased since the opening of Clackmannan Colliery, *ib.*—Attempts made by Alloa trustees to repress this injurious practice, *ib.*—Several parties prosecuted and convicted in consequence, *ib.*—Practice not abated by their proceedings, *ib.*—The authorities of Clackmannan and Stirlingshire made no attempts to prevent it, although prohibited by Act of Parliament under high penalties, *ib.*—Evidence as to increase of shoals and sand-banks from this cause, *ib.*—Extent of the evil described, *ib.* xxii. and xxiii., App. No. 85. —The same practice prevails to a considerable extent in the neighbourhood of Charlestown, and in nearly all the harbours in the Firth, Rep. xxii.

FORTROSE:

Has a harbour with high piers and 11 feet depth of water, finished in 1817, at a cost of 4000*l.*, Rep. xxxviii.—Chanonry Point, a dangerous spit of shingle a mile from the shore, is now marked by a fixed light, *ib.*

FRASERBURGH:

Present Condition of Harbour:—

This harbour has an area of eight acres, enclosed by north and south piers, with a middle pier or jetty, Rep. xxxiii.—It has a depth of 15 feet at the outer harbour and 12 feet at the inner at high-water springs, *ib.*

Management:—

Previous to 1818 the Harbour Commissioners were also members of the Town Council of Fraserburgh, elected by the superior, Lord Saltoun, *Begg*, 325. —By the Act 58 Geo. III., cap. 85, this management was continued until 1839. The present governing Act is 2 and 3 Vic., cap. 65, which repealed the former Acts, *ib.* 325.

Improvements Effected:—

North pier, designed by Rennie, erected in 1808 at a cost of 11,332*l.* 17*s.* 3*d.*; South quay, built about 1818, cost 6,611*l.* 4*s.* 6*d.*; the middle pier or jetty, in 1830, cost 5,654*l.* 18*s.* 3*d.*; and various excavations in the last six years, 2,103*l.* 4*s.* 7½*d.* Total cost of the different works, 25,702*l.* 4*s.* 7½*d.*, *Brown*, 329.

Improvements Suggested:—

Extension of piers, to give greater shelter to fishermen, much wanted, but prevented on account of the cost, Rep. xxxiv.—The cost of the design prepared for extending the piers estimated at 20,000*l.*, *ib.*—This sum too large for the harbour funds, *ib.*—Considering the position of Fraserburgh, the refuge it affords to wind-bound vessels, and the extent and value of its fisheries, is of opinion that there are few places on the coast where such a sum could be more beneficially expended, *ib.*

Income, Expenditure, and Debt:—

Income.—In 1841 the income amounted to 1698*l.* 4*s.* 6*d.*; in 1842 to 1864*l.* 4*s.* 8*d.*; and in 1843 to 1923*l.* 0*s.* 4½*d.*, *Begg*, 330.—1846, 2218*l.*, Rep. xxxiv; for 1844-5-8, see p. 654.—The dues are levied under the authority of the Act 2 and 3 Vic., cap. 65, *ib.*

FRASERBURGH—continued:

Income, Expenditure, and Debt—continued:—

Expenditure.—In 1841 the expenditure amounted to 1029*l.* 14*s.* 3½*d*; in 1842 to 2308*l.* 3*s.* 2½*d.*; and in 1843 to 1452*l.* 6*s.* 7*d.*, *Begg*, 330.

Debt.—The debt due on the 1st January, 1846, amounted to 12,496*l.*, *Begg*, 330.

Miscellaneous Papers:—

Return to Order of House of Commons of August, 1844, 325.—Letter from chief magistrate to Lord Saltoun, on the capabilities of Fraserburgh as a harbour of refuge, 328.—Memorial of fish curers, merchants, &c., of Fraserburgh, on the want of accommodation for fishing craft, 329.—Account of cost of improvements in the harbour, *ib.*

Reports of Engineers, &c.:—

Stevenson, on the harbour and a new south pier, 325.—Gibb on improving the harbour and estimate, 326.—Walker, on the capabilities of the harbour, and estimate for new works, 327.—Chalmers on the erection of the piers, 330.

Complaints:—

The Harbour Commissioners have received no written complaints of defects, &c., in the harbour, *Begg*, 325.—Fish-curers complained in 1845 of want of accommodation for fishing craft, 329, App. No. 221, Rep. xxxiv.

GARDENSTONE:

This harbour was built in 1740 by the proprietor of the estate of Troup, *Wernham*, 331.—Description of the harbour, Rep. lviii.—The dues fixed at that time have been levied ever since, *Wernham*, 331.

Income and Expenditure:—

Income.—In 1841, 87*l.*; in 1842, 81*l.*; and in 1843, 83*l.*, *Wernham*, 331; for 1844-5-6, see p. 654.

Expediture.—In 1841, 2*l.* 18*s.* 1*d.*; in 1842, 13*l.* 13*s.* 7½*d*; and in 1843, 6*l.* 11*s.* 11½*d*, *Wernham*, 331.

GARLIESTOWN:

This harbour, built by voluntary subscription and dues, collected by mutual consent without an Act of Parliament, *Stuart*, 595; *Waldie*, 595; *Bryce*, 595; *Pollock*, 595.—It cost 2000*l.*, *ib.*—An expenditure of 800*l.* on the breakwater would be beneficial to colliers and strange vessels seeking shelter, *ib.* —This improvement might probably be the means of saving many lives and much valuable property, *ib.*

Income, Expenditure, and Debt:—

Income.—In 1841, 116*l.* 11*s.* 7*d.*; 1842, 97*l.*; 1843, 401*l.* 6*s.* 1*d.*, *Stuart*, 595; for 1844-5-6, see p. 654.—Loan of 300*l.* taken in 1843 the cause of increase; *Stuart*, 595.—1*d.* per ton register the amount of harbour dues, *ib.*

Expenditure.—In 1841, 55*l.* 1*s.* 1*d.*; 1842, 281*l.* 7*s.* 9*d*; 1843, 435*l.* 19*s.* 7*d.*, *Stuart*, 595.

Debt.—Amount due 1st January, 1846, 555*l.*, *Stuart*, 595.

GARMOUTH:

This place not properly a harbour, being merely a creek or anchorage place, *Hogarth*, 337.—The dues are only 1*d.* per ton register on all vessels using the moorings, *ib.*—The Duke of Richmond is the proprietor, who lets it to witness for 12*l.* 10*s.* per annum, *ib.*—The arrivals in 1846 were 106 vessels of 5254 tons, Rep. xxxv. Income in 1844, 60*l.*; 1845, 70*l.*; 1846, 64*l.*, Supp. 654-5.

GATEHOUSE:

A proprietary harbour.—Description thereof, Rep. lviii.

Income and Expenditure:

Income.—In 1841, 26*l.* 17*s.* 7*d.*; 1842, 33*l.* 4*s.* 7*d.*; 1843, 33*l.* 18*s.* 1*d.*, *M'Adam*, 597; for 1844-5-6, see p. 654.—The dues are collected by the authorities of the Burgh without an Act of Parliament, *M'Adam*, 597.

Expenditure.—In 1841, 4*l.* 17*s.* 5*d*; 1842, 4*l.* 9*s.* 8*d.*; 1843, 5*l.* 2*s.* 11*d.*, *M'Adam*, 597.

GIRVAN:

Description of the harbour, Rep. lvi.—This harbour by charter belongs to the lands of Ballochtone, the property of the Duchess de Coigny, by whom it is maintained without reference to the revenue derived from it, *Wyllis*, 554.

Income and Expenditure:—

Income.—In 1842, 58*l.* 0*s.* 8½*d.*; 1843, 90*l.*; 1844, 55*l.* 6*s.*, *Wyllis*, 554; for 1845-6, see p. 654.

GIRVAN—continued:

Income and Expenditure—continued:—

Expenditure.—In 1842, 274*l.* 16*s.* 2*d.*; 1843, 283*l.* 11*s.* 7*d.*; 1844, 233*l.* 15*s.* 10*d.*, *Wyllis*, 554.

GLASGOW:

Present Condition of Harbour and River:—

The Harbour.—The present harbour space is about 21 acres, *Bremner*, 395.—An addition of 11½ acres will be added when the works in progress are completed, *ib.*—One-half of this increased space will be added to the harbour in two years, and the whole in four years from the present time (October, 1846), *ib.*—The width of the harbour is 420 feet, *ib.* 392.—This part proposed by Rennie to be 135 feet only, *ib.*—Statement showing the width of the river at different places, and the widths proposed by the different engineers, 467.—Statement showing the existing accommodation in the harbour as to quay room and water space, 478.—Depth of water in the harbour 17 feet at spring and 15½ feet at neap tides, *ib.* 394; *Johnstone*, 396.—At Glasgow Bridge the depth is 14 and 15 feet at neap tides, and 17 and 18 at spring tides, *Bell*, 405.—Formerly there were shallows with not more than 3 feet of water, *ib.*—A north-east wind makes a difference of 2 feet in the depth of water, *M'Connechy*, 412.—The depth of water has been increased in the last 30 years. There is no want of rings, cranes, &c., in the harbour, *Johnstone*, 396.—The largest crane will lift 45 tons, *ib.*—A larger crane about to be put up on the north bank of the river, *ib.*—There is only one patent slip in the harbour, *Hutchison*, 399.—The want of a graving dock much felt, *Chapman*, 399.—All the large ships are obliged to be sent to Liverpool to be repaired, *ib.*—Evidence as to the increased and increasing trade, and of the greater number and size of the vessels using the harbour, *Johnstone*, 395.—Necessity for further accommodation proved thereby, *ib.*—The pressure has long been felt, and is even on the increase, *ib.*; *Steele*, 415.—Evidence as to mode of berthing ships in the harbour, *Bell*, 403.—Vessels are frequently compelled to lie six and seven abreast, *Johnstone*, 396, 397.—Accidents of frequent occurrence from this cause, *ib.* 397.—Believes the majority of the accidents have been caused by so many ships lying abreast, *Russell*, 398.—Return of persons taken out of the harbour in 1845 and 1846, *Bell*, 403.—Is of opinion that other and better arrangements might be made so as to give greater accommodation, *ib.* 405.—Large vessels likely to remain long in the harbour should be sent into a basin to be provided for the purpose, *ib.*—The steam-boat interest should be accommodated between York-street and Glasgow Bridge, and the coasters above the bridge, *ib.*—Finds no greater difficulty in towing up vessels in the Clyde than in the Thames, or any other river, *M'Gregor*, 417.—Silting in the harbour very considerable, *Bald*, 421.—It is caused partly by the sewerage from the city, and partly by the deposition in the river during land floods and freshes, *ib.*—The deposition is greatest below Glasgow Bridge, and gradually diminishes towards the entrance of the harbour, *ib.*—Its removal is attended with considerable expense.

Stockwell Bridge Weir.—One of the greatest barriers to the improvement of the Clyde, *M'Lellan*, 389.—Expense of dredging increased by the continuance of the weir, *Bremner*, 393.—It is injurious to the property on the banks by forcing the water upward in freshes, and flooding the houses, *ib.*—Further evidence as to the prejudicial effect of this weir, *ib.*

Quays.—The stone quay walls were never laid sufficiently deep nor strongly enough piled in the foundations, *Bald*, 420.—The walls have been built 20 feet high, *ib.*—A depth of 24 feet of water now required in the harbour for the large ships, *ib.*—The quays now extend 7070 feet, *Drew*, 416.—They are in a very indifferent state, particularly those first built, *M'Lellan*, 390; *Johnstone*, 396.—A few months since 500 feet on the north side and 375 feet on the south side had given way, *Bremner*, 392.—The condition of the quays caused by dredging to a greater depth than was contemplated when they were built, *Johnstone*, 396; *Bell*, 405; *Turner*, 394.—They are sometimes overflowed in heavy freshes, *Bremner*, 394.—The damage done to property on these occasions very trifling, *ib.*—Flooding caused by the confined section of the river and the want of declivity in the bed of the navigable channel, *ib.*—Fresh water is laid down to the quays, *Johnstone*, 396.—Is of opinion that everything has been done consistent with the means of the trust to make the quays as substantial as possible, *Bell*, 405.—Considers the present stone quays may be made secure, and that they would then be preferable to timber, *M'Connechy*, 413.—Believes timber walls preferable to stone in Glasgow, *Forrest*, 414.—Decidedly recommends timber walls in preference to stone, *Bald*, 421.—The steam-boat timber wharfs have answered very well, *ib.*—Timber quays less than half the expense of stone, are quickly erected, more easily repaired, and are in no danger of coming down, *ib.*—If constructed of red pine and pitch pine, they would last, with attention, from 20 to 30 years, *ib.*—Replacing timber walls would cause far less inconvenience to the shipping than rebuilding stone walls, *ib.*

GLASGOW—continued:

Present Condition of Harbour, &c.—continued:—

Pilotage.—There are about 50 pilots, *Forrest*, 413.—Considers this number sufficient, but that the men are not efficient, *ib.*—Pilotage compulsory, but the practice of using steam-tugs has diminished their value, *ib.*—New system of examination about to be adopted before pilots are licensed, *ib.*—Examiners will consist of three members of the Pilot Board, all shipowners, who have been in command of vessels, *ib.*—The river pilots dependent entirely upon the Glasgow trustees, and unconnected with all others, *ib.*—The Glasgow Board does not licence pilots below Port Glasgow, *ib.*

Dredging.—The Clyde the first river on which the steam-dredge was used, *Bell*, 405.—It was introduced in 1820 or 1821, *ib.*—In the year 1845-1846 the dredging cost 8200*l.*, *Readman*, 408.—Between March and October, 1846, 78,110 cubic yards of sand and mud dredged up and removed in maintaining the harbour, 467.—In the same time 88,130 cubic yards of clay, boulders, gravel, and sand, were removed in deepening, widening, and maintaining the river, *ib.*—The expense now incurred for dredging amounts to about 8,000*l.* a-year, *Bremner*, 393.—89,000 cubic yards have been raised and deposited between Rashalee and Dumbarton, *ib.*—There is no tendency to fill up when once removed, *ib.*—The sand is brought down by the freshes at Rashalee; at Dumbarton a considerable quantity is brought up from the estuary to the tidal flow, *ib.*—Five machines have been constantly at work, dredging, until the present year, when four only are employed, *Johnstone*, 396.—Expense of dredging would be considerably lessened by increased tidal scour, *ib.*

The River.—The present state of the river nearly in accordance with Rennie's project of 1807, *Bremner*, 392.—From Renfrow to Glasgow the river varies in width from 170 to 250 feet, *ib.*—At Dunglass it is only 410 feet wide instead of 536 feet as proposed, forming a gut which impedes the flow of the tide, *Bell*, 404.—The deep channel varies in width from 150 to 300 feet, *M'Connechy*, 412.—If vessels keep the channel, does not think they will strike the ground in any part, *ib.*—Vessels drawing 17 feet of water now come up and down the river, *Gray*, 387, *M'Connechy*, 412.—The depth of water has been increased in the last 12 years by dredging between 2 and 3 feet, *ib.*—Many large boulders have been removed, but there are still some remaining, *ib.*—The boulders are lifted by a diving bell; has seen 30 tons removed in a week with the assistance of the deepening machine connected with it, *ib.*—Denies that many vessels get aground and lose their copper, *ib.*—Heavily-laden ships are sometimes detained two or three days by easterly winds and obliged to take out part of their cargoes, *ib.*

Tides.—The great detention in the Clyde is between Rashelee Quay and the pier at Clyde Bank, *Bremner*, 393.—This includes Newshot Isle, *ib.*—Difference of time of high water between Greenock and Glasgow, a distance of 18 miles, 1 hour and 45 minutes, *ib.*—Value of tidal observations in effecting improvements in the river, *ib.* 394.—Means adopted in Glasgow to register tides, *ib.*—Velocity of the tide above and below Newshot Isle, *Bald*, 419.—Rise of tide at different places in the harbour and river, *ib.*—The tide now flows up 3½ miles above Glasgow Bridge, *ib.* 420.—Statement respecting the tides in the Clyde, 466, 467.

GLASGOW—continued:

Present Condition of Harbour, &c.—continued:—

Dykes and Jetties.—There are still a few jetties in the river prejudicial to the tidal flow, *Bremner*, 393.—One at Dunglass, the other at Erskine Ferry, *ib.*—The dyke at Erskine Ferry is transverse, that at Dunglass longitudinal with the banks, *ib.*—Approves of parallel dykes as far down as Erskine Ferry on the left bank, and Dunglass Castle on the north bank, *Bell*, 404.—Objects to the slope of the dykes, *ib.*—The stones of the dykes have a tendency to roll into the channel, *ib.*—A slope of 2 to 1 necessary to insure stability, *ib.*

Newshot Isle.—A very serious obstruction to the flow of the tide, *M'Lellan*, 390.—The greatest obstacle to the flow of the tide is at this place, *Bremner*, 393.—The cross dykes in the south reservoir block up the tide and form overfalls at a certain level of the flowing tide, *ib.*—Newshot Isle comprises about 60 acres, *ib.*—The water space not long since was 102 acres, but this is considerably lessened, *ib.*—Present condition of the south channel, *M'Lellan*, 390, *M'Connechy*, 412.—The south channel must either be opened or closed entirely, *Bremner*, 393.—It is now in course of silting up, *M'Lellan*, 390.—Further evidence respecting Newshot Isle, *Turner*, 392.—Complaints have been made of small craft having been driven on the dyke, and of timber occasionally getting over it, *M'Connechy*, 412.—The dyke is in good repair, *ib.*—It is about the height of high-water neap-tides, but covered at spring-tides, *ib.*, Rep. xlix.

Lights, Buoys, and Beacons.—The lights about the Cambraes are sufficient, *Boyd*, 415.—The river trust keep up all the lights as far as the Cambraes, and the Commissioners of the Northern Lights all beyond, *ib.*; *M'Gregor*, 417.—Two additional lights are much wanted, one on the North Perch and another above Bowling, *ib.*—The want of these lights has caused some mistakes, *M'Gregor*, 418.

Management:—

The first charter granted by Charles I. in favour of the magistrates and town council of Glasgow conferred the alveus of the Clyde upon these parties as a public trust, *Turner*, 406.—In 1770 the corporation, by Act of Parliament, was created a trust for the management of the river, *ib.*—Four Acts have since been passed, *ib.*—The present governing Act is 3 and 4 Vic. c 118, *ib.*—The trust consists of 33 members, 23 of them being from the town council, *ib.*—The only qualification is residence within 7 miles of Glasgow, *ib.*—Appointment of resident engineer not compulsory under the Act, *ib.*—The trustees meet monthly, and there are also 5 or 6 extraordinary meetings in the year, *Turner*, 406.—Nine form a quorum; there is no difficulty in getting a proper attendance, *ib.*—Average number attending, two-thirds of the whole trust, *ib.*—An annual statement of the income and expenditure is printed and published, *ib.*—There are three standing Committees: the Finance Committee, the Committee on New Works, and the Committee on Existing Works, and other Committees for special purposes, *ib.*—[The Tidal Harbours Commissioner having looked over the Minute Book, the Treasurer's, and the Collector's Books, reported that, upon a cursory inspection, they appeared to be properly kept, 406, 408, 411.]—The directions as to bye-laws, &c., have all been properly obeyed in accordance with the Act of 1840, *Turner*, 406.—The dues are paid daily by the collector to the treasurer, *Readman*, 408.—The auditor has power to report on, but not to disallow any charge, *ib.*—The collector gives security to the amount of 2000*l.*, the treasurer 5000*l.*, *ib.*—The predominating influence of steam-boat proprietors alleged to be injurious to the general interests of the harbour, *Bell*, 402.—Believes that too little interest is taken in merchants' sailing-vessels, but does not impute improper motives to the steam-boat proprietors, who are members of the trust, and always on the spot, *ib.* 405.—Explanation of mode of election of trustees, *M'Lellan*, 406.—The latter acts of the trustees complained of for alleged waste of the revenues, and plunging the trust so much into debt, *Bell*, 405.—Considers that the trustees ought to be placed under some controlling power to prevent them from going to Parliament and getting so deeply into debt, *ib.*—Would have more persons connected with the shipping interest on the trust, *Mills*, 410.—Objects to a numerous Board, from the responsibility being so much divided, *ib.*—The mercantile interest alleged to be insufficiently represented, *Drew*, 417.—Considers that the present constitution of the Board might be very materially improved, *Mills*, 410.—Considers the yearly change of the majority of the members objectionable, *ib.*, Rep. xlix.—The members of the town council, from this cause, have not sufficient time to make themselves thoroughly acquainted with their duties as Harbour Trustees, *Mills*, 410.—Local prejudices and feelings alleged to prevail in the constitution of the trust, *ib.*—Would desire to have a resident Board, controlled by a superior power connected with and responsible to Government, *ib.*—Observations on the number of the trustees, and objecting to the shifting nature of the Board by the annual elections, *Gray*, 422.—Improved plans suggested by *M'Lellan*, 422, and by *Bell*, 477.

Income, Expenditure, and Debt:—

An Account showing the Revenue, Expenditure, and Debt from 1770 to 1846, 484.—Continuation of this account up to January, 1847, Supp. 665.—Return of Income and Expenditure of the Forth and Clyde Navigation in 1841-2-3, *Crichton*, 487.

Income.—The revenue is rapidly rising, and is sufficient to carry out the projected improvements, *Gray*, 387.—The increase chiefly caused by the increase of foreign trade, *ib.*—It has fluctuated considerably since 1836, *Bell*, 405.—It has varied since that time from 42,000*l.* to 48,000*l.*, *ib.*—26 years back the income was only 9,000*l.* a-year, at present it averages 45,000*l.* a-year, *M'Lellan*, 390.—Considers 25,000*l.* a-year, judiciously managed, amply sufficient for all the improvements required, *Bell*, 405.—The dues on vessels are only 2*d.* per ton, being lower than at any other port in the kingdom, *Muir*, 412.—1*s.* 4*d.* per ton charged upon goods, *ib.*—The amount of revenue much prejudiced by the want of accommodation in the harbour, *Steele*, 415.—In 1841-2 the income amounted to 40,678*l.* 16*s.* 8*d.*; in 1842-3, to 45,709*l.* 9*s.* 9*d.*; in 1843-4, to 43,841*l.* 9*s.* 4*d.*, 486; in 1844-5, 45,870*l.* 5*s.* 10*d.*; in 1845-6, 51,198*l.* 12*s.* 2*d.*; in 1846-7, 59,017*l.* 2*s.* 9*d*, Supp. 664. See also p. 656.

Expenditure.—Statement of the expenses incurred in obtaining various Acts of Parliament, and in opposing other Bills before Parliament, *M'Lellan*, 391.—Considers this a great burden on the funds, *ib.*—About 20,468*l.* has been expended altogether in proceedings before Parliament, *Hutchison*, 398.—Account of the sums expended in applications to Parliament, opposition to Bills before Parliament, and other law and judicial expenses, from 1836 to 1845, 486.—Does not consider this money imprudently expended, *Hutchison*, 398.—The establishment of a Government Board would avoid all this enormous expenditure, *ib.*—(*See* Management.)—The ordinary expenditure amounts to about 14,000*l.* a-year, exclusive of the interest of the debt, *Bell*, 405.—In 1841-2 the expenditure, including interest and rent of Windmillcroft, amounted to 91,456*l.* 4*s.* 5*d.*; in 1842-3, to 108,160*l.* 11*s.* 5*d.*; in 1843-4, to 81,219*l.* 7*s.* 7*d.*, 486. In 1844-5, the expenditure amounted to 50,113*l.* 18*s.* 1*d.*; in 1845-6, 81,230*l.* 18*s.*; in 1846-7, 261,607*l.* 5*s.* 8*d.*, the last year included an expenditure of upwards of 200,000*l.* for public improvements and new works, Supp. 664.

Debt.—The present debt about 500,000*l.*, *Bell*, 405.—This amount expected to be increased by 126,000*l.* for purchase of water-side ground-rents, *ib.*

Shipwrecks and Lesser Damage:—

Considerable damage occasionally done in the river by vessels breaking from their moorings, *Johnston*, 396.—Heavy freshes, particularly when accompanied by ice, cause severe damage, *ib.*—Collisions in the lower part of the river of frequent occurrence, *ib.*—Steamers frequently get aground at the bends before they can answer the helm, *Russell*, 397.—Large steamers frequently sustain extensive damage from getting aground in the river, *Boyd*, 414.—The damage to vessels from scraping their bottoms not so great as formerly, *ib.*

Shipping and Tonnage:—

Arrivals of sailing-vessels between July, 1845, and

GLASGOW—continued:

Shipping and Tonnage—continued:—

July, 1846, amounted to 5924, and their tonnage 342,735, *Johnston*, 396.—The arrivals of steamers in the same time amounted to 8485, and their tonnage to 775,233. Total of arrivals in 1845, 1846, 14,409, and total tonnage 1,117,968, *ib.*—Number and tonnage of registered vessels belonging to Glasgow, from 1811 to 1846, 480.—Comparative statement of foreign arrivals in 1828, 1845, and 1846, 481.—Abstract of shipping entering the port between July, 1832, and July, 1846, distinguishing all sailing-vessels drawing more than 6 feet of water, 482.

Maps and Plans:—

The last chart of the river between Glasgow and Greenock was made after 1840, *Turner*, 406.

Improvements Generally:—

The Clyde formerly improved by confining its channel, *M'Lellan*, 399.—This principle of improvement adopted in consequence of the limited amount of funds, *ib.* 389, 390.—The trustees have now large funds at their disposal, and they now purpose to improve the river by an entirely opposite course, *ib.* 390.—The plan of improvement now acted upon is to widen the river and not to narrow its course, *ib.* —The size and tonnage of vessels frequenting the harbour having increased from 100 to 600 tons, makes greater accommodation imperatively necessary, *ib.* —The removal of all the obstacles to the flow of the tide in the Clyde would accelerate the tide at Glasgow in time and height, *Bald*, 420.—The width proposed by the plan of 1840 too expensive to be carried out, *ib.* 421.—Modified plan proposed by witness and accepted by the trustees, *ib.*—Considers an average width of 350 feet from the harbour to the Cart, exclusive of the slopes of the banks, quite sufficient for any trade which Glasgow may ever have, *ib.*—Former engineers to improve the river, set up dykes; the present circumstances of the trade require the removal of these dykes in order that the river may be still further improved, *M'Lellan*, 390.—Has been generally favourable to half-tide dykes with beacons in the Lower Clyde and dykes to full tide in the Upper Clyde, *Bald*, 421.—The former to direct the current and give no obstruction to the tide, the latter to prevent the river banks from being washed away, *ib.*—All works are executed under contract; the Act prescribes that no work above 50*l.* shall be undertaken unless by contract or competition, *M'Lellan*, 390.—Considers it very desirable to afford facilities to bring the trade as far up the river as possible, *Bell*, 403.—Is decidedly opposed to the plan of opening Glasgow Bridge, *ib.*—Believes that the river has been too much narrowed, and that it is necessary to take advantage of some of the alveus to increase its width, *Drew*, 417.—Considers it desirable to obtain the greatest amount of tidal water for a scour, *Bremner*, 393; *M'Gregor*, 418; *Bald*, 420, —Knows no better mode of scouring, *Bremner*. 393.—The promotion of the tidal scour lessens the necessity for dredging and consequently diminishes the expense, *ib.*—Diminishing the influx of the tide diminishes also the tidal scour, *Bald*, 420. —The velocity of the ascending and descending waters necessary to the navigation, *ib.*—The increased influx of the water acts beneficially both by its weight and pressure for the general scour of the channel through all the reaches of the river, *ib.*—The promotion of the scour in the Clyde essentially necessary, as the rise of the tide is limited and the bed of the river nearly a dead level, *Bremner*, 393.—Would bring the tide up to the highest point by removing all obstructions, *ib.* 393; *Johnston*, 396; *Bell*, 404.—Increasing the flow of the tide six or seven miles above the quays would make the time of high water there half an hour later, *Bremner*, 393.

Proposed Railways and General Terminus.—The General Terminus Railway Company have obtained a right to 1200 feet of the harbour on the south side, *Bell*, 404.—This project, if confined to minerals, not very objectionable, *ib.*—Should have preferred bringing the railway to the Windmillcroft Basin, *ib.*—A mineral terminus near Govan would be better for the interests of the harbour, *ib.* —Evidence adverse to any railway crossing the river below Glasgow Bridge, *M'Lellan*, 391; *Johnston*, 396, 397; *Russell*, 397; *Bell*, 403.—Would allow no tampering with the deep-sea fishing, *M'Lellan*, 391.—A railway bridge might be constructed above Glasgow Bridge which would not interfere with the navigation, *Bell*, 404.—Plan delivered in for a railway to cross the Clyde above all the bridges, *Corsar*, 409.—Another plan to cross east of Stockwell Bridge submitted, *Muir*, 409.

GLASGOW—continued:

Improvements Effected and in Progress:—

Quays.—Length of, on north side, increased 900 feet, and on south side 300 feet, *Gray*, 386.—Since 1839, 1120 linear feet of stone quay walls, 166 linear feet of stone breast quay walls, with sheds, gas lamps, pipes, &c., have been completed, *Bald*, 420.—A wooden wharf, 500 feet long, has been erected on the north side, above Glasgow Bridge, *ib.*

Dredging.—Annual expense of dredging about 8000*l.*, *Bremner*, 393.—Four powerful steam dredges constantly at work operating on the bottom of the river. *M'Lellan*, 390; *Bald*, 420.—Account of quantity dredged in the harbour and river from March to October, 1846, *ib.*—Dredging above bridge prevented for the present, until the question of amount of compensation to be paid to the Bridge Trustees is settled, *ib.*

The River.—The removal of Port Glasgow Bank the greatest benefit conferred on vessels frequenting the Clyde, *Boyd*, 415; *M'Gregor*, 417.—A channel 300 feet wide and 700 yards long was cut through the bank, *Bald*, 418.—The depth of water increased from 3½ feet to 10 and 11 feet at low water, *M'Gregor*, 417.—At high-water springs it is now 22 feet deep, *Bald*, 418.—This depth is more than maintained, *ib.*—The removal of this obstruction by cutting the channel through it, the key which opened the navigation of the Clyde, *ib.*—A channel of the same width and depth as that cut through on Port Glasgow Bank, made on Garmoyle Bank, *ib.*—Vessels frequently grounded formerly on Garmoyle Bank, *ib.*—The removal of Garmoyle Bank and the bank at the head of the long dyke great improvements, *Boyd*, 415; *M'Gregor*, 417.—The banks at Dunglass, North Bar, and Finieston have all likewise been removed, *ib.* 417.—Six or seven feet of water gained at all these places by the removal of the obstruction, *ib.*—In 1846, between March and October, 450 stones, varying from half a ton to 5 tons in weight, were lifted by the diving-bell, 467.—The removal of the large stone boulders lying between Erskine Ferry and the west end of Newshot Isle an important and necessary operation in improving the navigation, *Bald*, 419.—The rough ground extended about 2000 yards, *ib.*—Vessels formerly frequently grounded at this place, and damage to a considerable amount sustained, *ib.*—At Spier's Ledge, about 4½ miles below the harbour, the bottom formerly consisted of boulders and stones of various sizes, *ib.*—These have been removed by the diving-bells, *ib.*—Some of the stones thus removed were worn away on the top by the keels of vessels rubbing over them, *ib.*—Ships frequently grounded at this place, *ib.*—At White Inch, on the right bank of the river, the point has been cut away for a distance of 800 yards, removing about 4 acres of land, *ib.*—The width of the river at this place increased to 410 feet, *ib.*—The point at Govan, 250 yards long, has also been removed, increasing the width of the river at this place from 170 feet to 300 feet, *ib.*—Evidence as to various operations at other places to straighten the river by cutting off points, &c., *ib.*—Summary of the various improvements in the river, Rep. xlviii.—The value and efficacy of these works considered, also whether they might not have been executed at much less cost, *ib.*

Improvements Suggested:—

Conservancy Board.—Opinions in favour of, *Campbell*, 385.—Objects to some of the details, but is favourable to the principle, *M'Lellan*, 391.—Is favourable to it as tending to lessen the expense of obtaining Improvement Acts, and avoiding Parliamentary expenses, *ib.*—Considers the establishment of a Government Board necessary to prevent the great outlay incurred in Parliamentary expenses, *Hutchison*, 398.—The interference of the Admiralty has already saved large sums, *ib.*—A

GLASGOW—continued :

Improvements Suggested—continued :—

local Board not competent to deal with such vast interests as are involved in the management of the Clyde, *Miles*, 410.—Local feelings and prejudices injuriously affect public interests, *ib.*—The superior controlling power should be vested in the Government, *ib.*—Approves of a controlling Board superior to and apart from local interests, *ib.* 412.—Opinion adverse to, *The Lord Provost*, 315.

In the Harbour, above Glasgow Bridge.—Opening the river above the bridge for the accommodation of small craft generally desired by the trustees, *M'Lellan*, 390; *Bremner*, 394.—Also much desired by the shipping interest, *Steele*, 415.—The Clyde Shipping Company have four steamers and nine lighters, all the latter would use the upper harbour if accommodation were afforded, *ib.*—Recommends deepening the river to 9 feet at high water to accommodate all vessels under 100 tons, *Bremner*, 395.—The trustees intend to make it 5 feet deep at low water, and at spring-tides 15 feet, *Gray*, 387; *M'Lellan*, 390.—Expense of deepening the Clyde between Jamaica-street Bridge and Stockwell Bridge to 17 feet at low water, and constructing quays, estimated at 77,355*l.* 9*s.* for timber quays, at 140,467*l.* 15*s.* for stone quays, *Bald*, 478.—Is decidedly favourable to the plan for extending the accommodation between the bridges, *Forrest*, 414; *Boyd*, 414.—The foundations of Glasgow Bridge will bear the increased depth, *M'Lellan*, 390.—The foundations of Stockwell Bridge will be weakened by the projected improvements, *Turner*, 407.—Amount of compensation to be paid by the River Trustees to the Bridge Trustees for this damage submitted to arbitration, *ib.*—Present state of this question, *ib.*—Amount of trust-money involved in this dispute stated to be 80,000*l.*, *M'Lellan*, 407.—This statement denied, and the amount stated to be considerably under this sum, *ib.*—Considers that the expense of securing Stockwell Bridge from the increased depth proposed will probably cost about 6000*l.*, *Bald*, 420.—It would certainly not amount to 10,000*l.*, *ib.*—A quay 1000 feet long intended to be built, *Gray*, 387.—Properly quayed and deepened the space between the bridges would relieve the present harbour of all the coasting trade, *Forrest*, 414.—The extension of the harbour upwards to Stockwell Bridge will prove very beneficial to the trade, *Hutchison*, 398.—The upper harbour ought long since to have been deepened and quayed, *Bell*, 403.—The improvement of the river above the bridge more urgently required than the construction of the docks at Windmillcroft, *Mills*, 411; *Steele*, 416.—More required also than the docks at Stobcross, *Steele*, 416.—Increased harbour accommodation more urgently required than the river improvements, *Bell*, 403.—The Act of 1840 compelled the harbour works to be first executed, *ib.*—This clause inoperative, and has since been repealed, *ib.*—Further accommodation for small craft necessary as the quays below the bridge are too high for this class of vessels, *Gray*, 388; *Bremner*, 394; *Steele*, 415.—Glasgow Bridge not necessary to be altered, as the owners of these vessels would fit them with folding masts when the new harbour is made, *M'Lellan*, 391; *Bremner*, 394; *Johnstone*, 395.—The small steamers would also be fitted with folding funnels, *Russell*, 397.—All the lighters would also use the harbour above the bridge, *Steele*, 415. Vessels of 100 tons now pass under Glasgow Bridge, *Gray*, 388, Rep. xlviii.

Stockwell Bridge Weir.—The removal of the weir at Stockwell Bridge generally desired by the trustees, *Gray*, 386, 387; *M'Lellan*, 389; *Anderson*, 389; *Drew*, 416.—It is proposed to be removed to a point in the river about 100 yards east of Hutchison's Bridge, *Gray*, 386.—This would be of no value as an upper scour, *M'Lellan*, 389.—The trustees have agreed to pay a sum towards the expense of removal, the amount to be decided by arbitration, *Gray*, 386.—Strongly objects to the re-erection of the weir, *M'Lellan*, 389.—Considers it desirable to remove the weir altogether, *Hutchison*, 398; *Drew*, 416; *Russell*, 397; *Johnstone*, 396; *Bremner*, 393; *Turner*, 389; *M'Lellan*, 389; *Gray*, 386.—A committee of the trustees have unanimously reported in favour of its entire removal, *M'Lellan*, 388.—Further evidence relative to the proceedings on this question, *ib.* 388; *Anderson*, 389.—Its removal objected to by some who fear that the additional scour would injure the banks, *ib.* 386.—And also because the water companies, the trustees of the bridge at Rutherglen, and the manufacturers are all interested in its continuance, *Turner*, 389.—The opposition of these parties can be overcome by granting them compensation, *M'Lellan*, 389.—The removal of the weir at present would deprive Glasgow of water, *Lord Provost*, 389.—Statement of difficulties which would ensue from its utter removal, *Anderson*, 389.—An extended flow of the tide 6 or 7 miles up the river one of the advantages which will be derived from its removal, *Anderson*, 390.—The increased tidal scour would save one-half the expense now incurred in dredging the harbour, *M'Lellan*, 389; *Bremner*, 393; *Johnstone*, 396.—Overflow on Glasgow Green feared from its removal, *Anderson*, 389.—An embankment would stop this, *ib.* 389.—The removal of the weir would, in fact, lessen the chance of a flood, *M'Lellan*, 390.—The health of the city would be improved by the removal of the weir, *Bremner*, 393.—The weir, so called, is simply an embankment of stones to keep up the head level of the water for the Water Company, *Bell*, 403.—Would reduce the obstruction by degrees, to prevent the increased tidal scour injuring the banks of the river, *ib.*—Injurious effect of these obstructions described, Rep. xlviii.

In the Harbour.—Opening Glasgow Bridge. Evidence in favour of; would rather open Glasgow Bridge than make the docks at Stobcross, *Hutchison*, 398.—The bridge must be taken down and rebuilt, with a drawbridge in the centre, *Bald*, 422.—It would be opened only during the night tides when no traffic was going over it, *ib.*—Does not think it would cause much inconvenience to the inhabitants, nor be dangerous to property, *ib.*—Evidence adverse to.—Considers it inexpedient under any circumstances to make an opening in this bridge, *Bell*, 403.—Objects to it on account of the great intercourse between the two sides of the river which this plan would impede, *ib.*—Is unfavourable to the plan of altering the bridge, *Forrest*, 414; *Steele*, 416.

In the Harbour, below Glasgow Bridge.—The masters of the American vessels all concur in preferring accommodation in the river to the proposed docks, *Mills*, 411.—Would increase the harbour accommodation as much as possible before constructing any docks, *Mills*, 411; *Bald*, 421.—Would recommend deepening and straightening the approach to the harbour and removing the boulders from the bed of the river, *Forrest*, 414; *Boyd*, 415.—Would also cut off the bends, *ib.*—Large vessels could depart more regularly from a tidal basin than from a dock, *Boyd*, 414.—Is in favour of a tidal harbour with a wide entrance, so as to enable large ships and steamers to enter and depart at all times, *Bald*, 421.—The works suggested in the upper and lower harbours, and the tidal basin at Windmillcroft should be completed before the docks are constructed at Stobcross, *ib.*

Docks at Windmillcroft.—Land has been purchased for docks at this place, *M'Lellan*, 390.—This work has never been proceeded with, *Gray*, 388.—The soil stated not to be suitable for impounding water, *M'Lellan*, 390.—It is still retained by the trustees at an expense of 1600*l.* per annum, *ib.*—Some revenue is, however, derived from it, *ib.*—About 10,000 or 12,000 yards now applied to the purposes of the harbour, about 40,000 yards remaining undisposed of in the hands of the trustees, *Hutchison*, 399.—This space would accommodate (allowing every vessel to remain one month in dock) 1000 square-rigged vessels annually, or 240,000 tons of shipping, *Bell*, 403.—The project abandoned in consequence of a report from Mr. Bald, *Hutchison*, 399.—It was abandoned because the ground was stated to be spungy, and full of running mud, and that it would require an enormous outlay to consolidate it, *ib.*—Agrees in the propriety of abandoning the project, *ib.*—Believes that the docks were not made because they would not benefit the steam-boat interest, *Bell*, 402.—Walker thinks it a good place for a graving dock, *Turner*, 399.—The construction of these docks not abandoned, *ib.* 406.—The work postponed from its re-

GLASGOW—continued:

Improvements Suggested—continued:—

quiring so long a time to complete it, and the necessity for making an immediate increase in the harbour accommodation, *ib.*—On these grounds the extension of the quays first proceeded with, *ib.*—Bald has bored the land 100 feet, and reported that there would be no difficulty in making Windmillcroft into a tidal basin, with quay walls as deep as the present quay walls in the harbour, and as easily, the subsoil being the same, *Bell* 403.—Evidence of harbour masters, &c., in favour of this scheme, *ib.*—Windmillcroft the best and only place on the north side for large foreign vessels, *ib.* 405.—Should not be deterred from making the excavation by the alleged difficulty and expense, *ib.*—Prefers docks at Windmillcroft to Stobcross, *Steele*, 416.—Would first increase the accommodation in the harbour to its utmost extent, and then construct the docks at Windmillcroft, *Mills*, 411.—When this is found insufficient, would eventually make the docks at Stobcross, *ib.*—Does not think Windmillcroft suitable for a dock, *Forrest*, 414.—Not so suitable as Stobcross, *Boyd*, 414.

Docks at Stobcross.—Ground has been purchased under the Act of 1846, to form docks at this place, *Gray*, 386.—The proposed dock to have an area of 17 acres, and a quayage of 1000 feet, *ib.*—The acquisition of the lands all that has yet been done, *Turner*, 392.—It is not intended at present to proceed with the works, *ib.*—The funds of the trust insufficient to carry out these improvements, *M'Lellan*, 391; *Hutchison*, 398.—Prefers docks at this place to any other place near Glasgow, *Forrest*, 414; *Boyd*, 414.—The distance is not more than a mile from the principal cotton and other stores, *ib.*—Does not consider the expense of cartage so great as to make the river preferred by merchants, *ib.*—Objects to making the docks at Stobcross, would rather open Glasgow Bridge, *Hutchison*, 398.—Objected to on account of the heavy expense which would be incurred for cartage, *Bell*, 404.—The cartage to Stobcross would be more than all the harbour and river dues, *ib.*—The railway companies would chiefly benefit, *ib.*—Rather than build docks so far from the harbour, should seriously consider the propriety of taking down Glasgow Bridge, and rebuilding it higher up at Jamaica-street, *ib.*—Objections to docks at Stobcross, in consequence of expense of cartage, *Steele*, 416.—Expense of making tidal basin to contain 32 acres of water, with a lie-by for vessels of 8 acres, and 17 feet deep at low water, with timber quays estimated at 266,076*l.* 2*s.*, and for stone quays 446,099*l.*, both exclusive of the land, *Bald*, 479.

In the River.—The width of the river, instead of being 170 feet only as it is in some places, will, if the projected improvements are carried out, average 400 feet wide, *M'Lellan*, 390.—Recommends all the quick bends in the river to be cut off, and the river to be widened where necessary, *Johnston*, 396.—Widening and deepening the river below the harbour proposed to be done to allow large vessels more easy access, *Gray*, 386.—Does not think it desirable to widen the navigable channel to the extent of the Parliamentary lines, on account of the great expense, and also on account of the extra dredging which would be required, *Bell*, 404.—Where the river is now 200 feet, would make it from 260 to 300 feet wide, and gradually increase it downwards to Erskine Ferry or Dunglass, *ib.*—Would straighten the river as much as possible at the entrance of the Leven, near Dumbarton Castle, *Bell*, 405.—Would remove the Garmoyle Lighthouse, and put it on the line of the river, *ib.*—Would remodel and reconstruct all the entrance works in the Lower Clyde, and most of the river dykes, *Bald*, 421.

Newshot Isle.—To improve the south channel, should take up all the walls in the middle and erect a higher wall at the east end, *Bremner*, 394.—Opening the upper end of this channel would cost from 1200*l.* to 1500*l.*, *ib.*—The south channel, if opened, would be more direct; the distance saved would be 120 lineal yards, *ib.*—Approves of opening the south channel, *Bell*, 404.—Opening the south channel would cause a greater tidal flow up the Cart, *ib.*—The preservation of the dyke in the south channel necessary for the safety of the small craft, *M'Connechy*, 412.—Would prefer improving the present channel to opening the south channel, *Hutchison*, 399.—Reason for the preference, *ib.*—Rennie, Telford, and Walker all concur in preferring the north channel, *Turner*, 407.—Borings of the south channel have been made by Mr. Aird, and are now in the hands of the engineer, *Turner*, 407.—[The Tidal Harbours Commissioner suggested that fresh borings should be made, which the trustees acceded to, 407.]—Walker considers that the south channel should be kept open as a channel for the tide, *Turner*, 407; *M'Connechy*, 413.—To open the south channel, blasting the rocks as well as the removal of the dyke necessary, *M'Connechy*, 413.—Mr. Aird considers that rock and not boulders the difficulty in deepening this channel, *ib.*—Opening the south channel would greatly increase the tidal scour, and be the means of keeping the river clear, *Bald*, 418.—Prefers an open channel to a reservoir, *ib.*—It would be more beneficial if made entirely open, *ib.*—Denies that there are any grounds to suppose that both channels cannot be maintained, *ib.*—The old maps of the Clyde show two channels, one averaging 710 feet, and the other 790 feet wide, *ib.*—Evidence as to velocity of the tide above and below Newshot Isle, *ib.* 419.—These velocities show that the flow of the tide is impeded by shutting up the south channel, *ib.*—The velocity of the tide would be increased by opening the south channel from 6 to 8 miles an hour to 10 or 14 miles an hour up to Clyde Bank, *ib.*—Further evidence as to probable effect upon the tides, &c., in the river and harbour by opening the south channel, *ib.*

Dykes.—The half-tide dykes should be raised, as vessels are apt to get on them and break their backs, *Bell*, 404.—Would prefer their entire removal, or at least that they should be put much further back, *ib.*—Would place a dyke on the left bank of the Clyde off Bowling, to remove the deposition which at this place is considerable, *Bald*, 418.—Erection of dyke at this place resisted by Lord Blantyre, the owner of the adjacent land, *ib.*—Denies the power of any landed proprietor to interfere with the improvement of a tidal river, *ib.*—Would set the dyke from Dunglass to Dumbarton more to the southward, to lessen the impediment to the flow of the tide, *Bald*, 421.

Lights.—Two additional lights are much wanted, one on the North Perch and another above Bowling, *Boyd*, 415.—These lights will be made upon a proper representation to the Trust, *ib.*; *M'Gregor*, 417.

Complaints:—

Want of accommodation in the harbour greatly complained of, *M'Lellan*, 390; *Drew*, 416; Rep. xlix.—Has had repeated complaints of want of water for large steamers and foreign vessels, *Johnston*, 396; *Mills*, 410.—Receives complaints almost daily from masters of large steamers as to the narrow parts of the river and the difficulty of turning corners, *ib.*; *Russell*, 397.—Steamers frequently get aground at the bends before they can answer the helm, *ib.*—Complaints of want of width refer more particularly to the space from Renfrew upwards, *Bell*, 404.—To meet these complaints, it is proposed to widen the river considerably, *M'Lellan*, 390.—And generally by carrying out the plan of 1840 on the north and south sides of the river, and above and below the bridges, *ib.*—Complaints of collisions in consequence of the narrowness of the river much less frequent than formerly, *Steele*, 415.—Conduct of trustees complained of in respect of the actions relating to encroachments, *Bell*, 400.—Petition to House of Lords on this subject, *ib.* 401.—Trustees alleged to have given up their title to the alveus land when secured to them by an Act of Parliament, *ib.* 400.—Expenses incurred for compensation stated to be unnecessarily increased from this cause, *ib.*—General management of trustees alleged to be inefficient, *ib.* 402.—Complains particularly of the latter acts of the trustees wasting the revenues and plunging the trust so much in debt, *ib.* 405.—Inequality of dues complained of, that lighters plying between Glasgow and Greenock pay 2*d.* per ton, while steamers pay only 1*d.* per ton, *Steele*, 412-415.—Is aware that their charges are in accordance with the Act of 1840, *ib.*—Witness has recently

GLASGOW—continued:

Complaints—continued :—

refused to take 1900 bales of cotton on account of the heaviness of the dues as compared with Greenock and other ports, *ib.*—Delays occasioned by the narrowness of the river in some places much complained of, *Boyd*, 414.—Has often been nearly two hours in getting from a little below Govan to to the harbour, *ib.*—Large steamers have great difficulty in passing in certain places, *ib.*; *Drew*, 416.

Reports of Engineers, &c.:—

Smeaton, on deepening the Clyde, 1755, 424.—Rennie, on the obstructions in the Clyde near the bridge, 1799, 430.—Telford, on increasing the tidal water and forming a dock at Broomielaw, 1806, 431.—Rennie, 1809, 441.—Rennie, on extending Broomielaw Quay, 1821, 443.—Telford, on enlarging Broomielaw Harbour, 1826, 446.—Hartley, on the same, 1834, 446.—Rennie, on a wet dock in the channel of the Clyde, and at Windmillcroft, 1807, 433.—Remarks by Rennie on the same, 1807, 435.—Reports on the improvement of the Clyde; Smeaton, 1755, 424; Golborne, 1768, 425; Watt, 1769, 427; Rennie, 1807, 436; Whidbey, 1824, 444; Clark, 1824, 445; Logan, 1835, 448.—On the river and harbour, Walker, 1836, 455; Russell, 1838, 458; Bald, 1844, 468; Bethune and Denison, 1846, 472.—Telford, on a dock in Dr. Reid's ground, 1819, 443.—Russell, on the tidal wave in the Clyde, 1838, 458.—Bald, on the river between Jamaica Bridge and Glasgow Waterworks, 1839, 464.—Estimate, by Bald, of the expense of converting the Clyde between Jamaica-street Bridge and Stockwell Bridge into a floating basin 17 feet deep at low water, 478.—Estimate, by Bald, of expense of making tidal basin at Stobcross, 479.—Wilson on the river Cart, Supp., 669.

Miscellaneous Papers.—

Return to Order of the House of Commons, 1845, 423.—Sums paid for surveys, reports, &c., 1752-1834, 447.—Statement of comparative levels of the tides on the Clyde, and width of the river at different places, 460.—Report by Bald, Johnstone, and Russell as to the propriety of laying rails on the quays at Glasgow for mineral traffic, &c., 1844, 470.—M'Lellan, on the proposed weir across the Clyde, 1846, 475.—Appendix to Mr Bell's evidence, 477.—Paper, Clyde Trustees and Bridge Trustees, 479.—Account of customs duties collected at the port of Glasgow, and registered shipping belonging thereto, from 1811 to 1846, 480.—Account showing extent and value of the ground, distinguishing the alveus land purchased by the Clyde Trustees, 481.—Comparative statement of foreign arrivals and departures in 1828, 1845, and 1846, 481.—Account of the number of shipping which arrived in the port from July, 1832, to July, 1846, distinguishing the sailing vessels drawing more than 6 feet of water, 482.—Statement of revenue and expenditure and debt, from 1770 to 1846, 484.—The foregoing statement continued up to June, 1847, Supp., 665.—Return of income and expenditure in the years 1841-2, 1842-3, and 1843-4, 485-6.—Statement of expenses incurred by the Clyde Trustees for law and jury expenses from 1836 to 1845, 486.—Income and expenditure of the Clyde Trustees in 1844-5, 1845-6, and 1846-7, Supp. 664.—Expense incurred for deepening the Clyde, constructing jetties, dykes, beacons, lights, and Bowling Basin, from 1770 to 1845, Supp., 667, 668.

GOURDON:

A small harbour, well protected by an eastern pier and detached breakwater, Rep. xxxi.—This work was erected at a cost of 2000*l.*, half of which was contributed by Government, *ib.*—The entrance is narrow and crooked, but marked out by beacons, *ib.*—The arrivals in 1846 were 77 vessels of 3638 tons, Rep. xxxi.—27 fishing-boats, employing 82 men, are connected with the port, *ib.*—The dues are levied under 4 and 5 Vict. cap. 49, 260.

Income.—In 1841, the income amounted to 99*l.* 14*s.* 5¾*d.*; in 1842, to 104*l.* 15*s.* 8½*d.*; and in 1843, to 172*l.* 11*s.* 11*d.*, 260; for 1844-5-6, see p. 658.

Expenditure.—The expenditure in the three years 1841, 1842, and 1843, stated to have been 2000*l.* 260.

GRANGEMOUTH:

Present Condition of Harbour:—

This place is at the eastern entrance of the Forth and Clyde Canal, at the confluence of Grangebourn with the Carron, Rep. xxi.—The harbour has recently been enlarged and improved by a wet dock of four acres, and timber basins of 17 acres in extent, *ib.*—The channel of the Carron is confined by embankments to a width of 120 yards, faced with stone, a mile in length from the mouth of the Grange, to low-water mark on the Forth, giving a depth of 21 feet at high-water springs, and 15 feet at neap tides, up to the docks, *ib.*—Description of the docks and trade of the port, *ib.*—The low-water channel is to be deepened to five feet, and a lighthouse erected to mark the eastern entrance, *ib.*

Income and Expenditure of Port of Grangemouth:

Income.—In 1841, 523*l.* 3*s.* 5*d.*; in 1842, 751*l.* 0*s.* 2*d.*; and in 1843, 1212*l.* 1*s.* 3*d.*, *Crichton*, 144; for 1844-5-6, see p. 656.—The dues are collected under the authority of the Forth and Clyde Navigation Act, passed in 1841, *Crichton*, 144.

Expenditure.—In 1841, 153*l.* 9*s.* 11*d.*; in 1842, 161*l.* 11*s.* 7*d.*; and in 1843, 192*l.* 17*s.* 3*d.*, *Crichton*, 144.

Income and Expenditure of Pollok's Wharf.

Income.—In 1841, 38*l.* 9*s.* 9*d.*; in 1842, 11*l.* 19*s.* 1*d.*; and in 1843, 28*l.* 19*s.* 9*d.*, *Pollock, Gilmour, and Co.*, 144; for 1844-5-6, see p. 656.—The dues are levied under the authority of an Act of Parliament, *Pollock*, 144.

Expenditure.—In 1841, 6*l.* 10*s.* 7*d.*; in 1842, 4*l.* 6*s.* 6*d.*; and in 1843, 6*l.* 2*s.*, *Pollok, Gilmour, and Co.*, 144.

GRANTON:

Present Condition of Harbour:—

This pier was completed in 1845; it is built of stone from the neighbouring quarries; it is 570 yards long and 53 yards broad, with a depth of 11 feet at its outer end at low water, and 30 feet at high-water spring tides, Rep. xxi.—It is amply furnished with jetties, slips, cranes, and every requisite for a complete pier, *ib.*—A red light is shown at the pier head, where is also a self-registering tide gauge, *ib.*—Evidence as to trade and shipping, &c., *ib.*—The income in 1844 amounted to 3170*l.* 3*s.* 9*d.*; in 1845 to 3546*l.* 16*s.* 7*d.*, and in 1846 to 3358*l.* 10*s.* 1*d.*, Supp. 658.

Reports of Engineers, &c.:—

Walker, on the site for a new pier, 1835, 138.—Stevenson, on a harbour at Granton, 1844, *Supp.* 625.

Miscellaneous Papers:—

Abstract of exports and imports at Granton Pier in the years 1843-1846, 143.

GREENOCK:

Present Condition of Harbour:—

It occupies the most advantageous position on the west coast of Scotland, Rep. lii.—It lies sufficiently within the Clyde to reap all the benefit of its inland navigation and the security of a river, yet seaward enough to be free from all shallows, and deep enough to enable the deepest laden ship to arrive at, or depart from, its sheltered roadstead at all times of tide, in all weather, by day and by night, Rep. lii.—The entrance of the east harbour is 150 feet wide, and of the west 120 feet, *Allen*, 497.—The port easy of approach from the sea, and pilots are not generally required, *Shannon*, 494.—It is buoyed and lighted all the way, *Allen*, 497; *Cumming*, 498.—Has been at sea thirty years, and does not know any port more easy of access than Greenock, *Hamlin*, 499; *Hunter*, 501, *Miller*, 502.—The water in the roadstead is from 24 to 12 feet deep at neap tides, *Shannon*, 494.—There is sufficient depth in the roads for the largest vessels at all times of the tide, *ib*; *Miller*, 502.—Vessels frequently lie in the roads in severe gales in perfect safety, *Shannon*, 494; *Miller*, 502.—There are screw anchors (Mitchell's patent screw moorings) in the roadstead, *ib.*—The Greenock Bank at low water forms a breakwater against the north-east wind, the only one that blows into the harbour, *ib.* 494.—Thinks the bank is rather increasing towards the east, *ib.* 495; *Miller*, 502.—Cannot tell the extent of the alteration, as it is only recently that plans have been made and correct soundings taken, *Shannon*, 495.—It can do no injury to the harbour, *ib.*—The bottom of the harbour is generally of soft clay, *ib.*

GREENOCK—continued:

Present Condition of Harbour—continued:—

494.—Ships not endangered in the slightest degree by lying aground. *ib.*—Vessels never break from their moorings if properly moored, *ib.* 495.—Evidence relative to the tides, *Allen*, 496.—Several tide gauges kept, *ib.*; *Miller*, 502.—There is a little deposit in the harbour from the river, which is easily removed by dredging, *Shannon*, 494.—There is a dredging-machine belonging to the harbour trustees, *ib.*—The harbours do not admit of further dredging. *ib.* 495; *Allen*, 496.—Vessels now take the ground more frequently than they formerly did, *ib.* 495.—The increased size of the vessels using the port probably the cause of this, *ib.*—The channel between the quays and the bank is getting deeper from the greater scour of the river, *ib.*; *Allen*, 496.—Evidence as to the trade of the port, *Shannon*, 495.—Expected to be largely increased, from construction of various railways now in progress, *ib.*—As to extent of trade, in building and fitting large iron steamers, *ib.*; *Allen*, 496.—Prefers Greenock to Glasgow; vessels are despatched much quicker from the lower ports than from Glasgow, *ib.*—Owners do not like their vessels scraping the ground in getting up to Glasgow, *ib.*—Has known a vessel coming down lie in the river nine days dragged from place to place at each tide, *ib.*—Vessels also occasionally lie as long a time for water to take them up, *ib.*—Increased accommodation particularly necessary for timber-vessels, *Shannon*, 494.—Vessels in this trade range from 400 to 1200 tons burden, *ib.*—Ships are not sufficiently nor promply attended to in regard to berthing. *ib.*—Timber-ships are better accommodated in a tidal harbour than in a wet dock. *ib.* 495.—Has seen from ten to fourteen timber-ships discharging their cargoes at one time, *Allen*, 496.—These are sometimes interrupted by the weather, *ib.*—A dock would be blocked up in a week if they could not discharge the cargoes, *ib.*—Further evidence as to extent of trade and accommodation afforded in Greenock, *Cumming*, 498; *Hunter*, 501; *Allen*, 497.—Number and size of steam-ships now building, *Balderston*, 498; *Cumming*, 498.—Greenock not fitted for wet-docks, from the small rise of the tides, *Shannon*, 494.—It is well supplied with graving docks, patent slip and building slips, cranes, &c., *ib.* 495.—Widths of some of the docks, *Allen*, 496.—The peer about to be erected by the Railway Company eastward of the harbours will not interfere with the current, if kept within the line of the present harbour, *ib.*

Pilotage.—Pilots are licensed by the magistrates, *Gray*, 493.—They are sufficiently numerous, *Shannon*, 494; *Hamlin*, 499.—Pilotage not compulsory; considers that it ought to be made so, *ib.*—But would not apply this rule to steamers trading regularly, *ib.*—The masters of steam-tugs are all pilots, and these usually take vessels far out, *Hamlin*, 499.—Would not make pilotage compulsory on this account, *ib.*—The pilots complain of not being sufficiently employed, *ib.*—Pilots keep boats of 20 or 24 tons, and maintain the crews at an expense of 8*l.* per month, *Miller*, 502.—Duties and conduct of pilots, stated and complaining insufficiency of remuneration received, *ib.* 502.

Quays.—The quays are built on cassoons and piles, and everything done to increase the depth of water that can be done with safety, *Shannon*, 495.—Evidence as to the set and force of the tides along the quays, *Miller*, 502.—Would not erect wooden quays outside the harbours, unless the piles were copper sheathed, as there is a worm very destructive to the timber, *ib.*

Lights.—The approaches to the harbour are well lighted and buoyed, *Allen*, 497; *Miller*, 502.—The part below Greenock is under the charge of the Cumbray Lighthouse Trust, managed at Glasgow, *ib.*—It is sufficiently done, *ib.*

Management:—

The 24th Geo. II., the first Act obtained for regulating Greenock, *Gray*, 493.—The 13th Geo. III, the next Act, vested the harbour in the bailies and town-council, *ib.*—Certain Commissioners under this Act appointed to co-operate with the trustees, *ib.*—Number of trustees increased by subsequent Acts, and their powers extended, *ib.*—The Act 5 Vic., cap. 54, gives power to raise 220,000*l*, *ib.*—The bye-laws authorized by the Acts have been carried out, *ib.*—The Harbour Trust now consists of sixteen members, chosen by the Parliamentary electors as councillors, and who, as such, are harbour-trustees, *Gray*, 493.—There are always ship-owners, and frequently retired ship-masters among the council, *ib.* 494. The trustees are also Commissioners of the harbours in conjunction with nine gentlemen, paying at least 12*l.* a-year of harbour-dues, who are elected by owners and part owners of ships trading to the port paying at least 3*l.* a-year of harbour dues, *ib.*—The Commissioners sanction new works authorized by trustees, and audit their accounts, *Gray*, 494; *Martin*, 501.—Trustees not allowed to take contracts for works, *ib.*—No practical inconvenience has arisen from the existing laws, *Gray*, 494.—Nor any complaints received regarding the management by the trustees of the harbours, *ib.*—Eight trustees form a quorum; the meetings held monthly, and oftener if necessary, *ib.*—[The Minute Books and Letter Books, &c. examined by the Tidal Harbours Commissioner, who reported that they appeared, from a slight examination, to be well and carefully kept, 494.]—Titles of the charters and Acts of Parliament relating to the harbours, 503.

Income, Expenditure, and Debt:—

Income.—The dues levied on vessels are considerably less than the authorized rate, *Gray*, 493.—Schedule of bay anchorage dues, 516.—In 1843 a large reduction on the rate of dues was made, *Shannon*, 494.—The dues are remarkably light, *Hunter*, 501.—Knows no port where the dues are so light as at Greenock, *ib.*—In 1830 the receipts from harbour dues amounted to 11,140*l.* 16*s.* 7*d.*; in 1835, 13,807*l.* 19*s.* 8*d.*; in 1840, 15,737*l.* 13*s.* 8*d.*; in 1841, 16,759*l.* 18*s.* 5*d.*; in 1842, 14,044*l.*; in 1843, 12,661*l.*; in 1844, 11,526; in 1845, 14,564*l.*; and in 1846, 14,320*l.*, *Baine*, 494; *Martin*, 501, Supp. 656.—Acts under which the dues are levied, *Martin*, 517.—The reduction of the rates in 1842-44, amounted to about 20 per cent., and caused a loss to the revenue of 2000*l.* a-year, *Shannon*, 494; *Hunter*, 501.—An account of the gross revenue received from 1824 to 1846.—In 1841 the income amounted to 18,356*l.* 3*s.* 9*d.*; in 1842, to 15,368*l.* 10*s.*; and in 1843, to 13,834*l.* 9*s.* 10½*d.*, *Martin*, 517.

Expenditure.—In 1841, 12,199*l.* 6*s.* 8*d.*; in 1842, 15,798*l.* 5*s.* 9*d.*; and in 1843, 10,387*l.* 17*s.* 4½*d.*, *Martin*, 517—These sums include the interest of money borrowed and the expenditure for new works, *ib.* 517.

Debt.—The debt due in September, 1846, amounted to 110,070*l.*, *Martin*, 502, 516.—This sum includes the amount expended for purchase of property for the new works, *ib.*—The net debt against the old harbours is 41,324*l.*, *ib.*—Within the last twenty-two years the old debt has been reduced about 79,000*l.*; the trustees having in this period also expended upwards of 20,000*l.* out of the surplus revenues in extensions of works, &c., *ib.*—The debt due on account of the old harbours in 1824 amounted to 120,186*l.*, and amount paid off in each year since that time, 516.

Maps and Plans:—

The plan of the new harbour and works now being constructed at present with the Admiralty, *Gray*, 493.

Shipping and Tonnage:—

Arrivals and departures in 1845, 1513 ships, 370,831 tons, *Shannon*, 495.—This number, inclusive of passenger steamers and vessels in ballast, *ib.*

Shipwrecks and Lesser Damage in the Clyde:—

Considerable injury sometimes done to ships in the river from their getting aground on shoals and dykes, *Allen*, 496.—The "Mohawk," "Glenbervie," "Eglinton," "Jane Brown," "Akbar," and many others, much injured from this cause, *ib.*; *Cumming*, 498; *Hamlin*, 498.—Ships frequently come into dock at Greenock to refit and repair, damage sustained in coming down the river, *ib.*—Confirms the evidence relative to nature and extent of damage done to shipping by getting aground in coming down the river, *Cumming*, 497.—Knows many other cases of injury to ships besides those stated in evidence, *Hamlin*, 498.—The "Nelson," GREENOCK—continued:

Shipwrecks and Lesser Damage, &c.—continued:—

built at Dumbarton, had her false keel knocked away, a large portion of her copper rubbed off, her keel injured, and a considerable quantity of her cargo damaged in coming down the river from Glasgow, *ib.*—Has frequently seen vessels aground in the river, *ib.*—Extent of damage done to the emigrant ship, "Charlotte Harrison," in 1845, by striking the ground, *M'Intyre*, 500.—Loaded ships frequently damaged in coming down the river, *Hunter*, 501.—The "Eglinton" was damaged in the harbour by being wrongly berthed, *ib.*—Has frequently seen vessels aground in every part of the river, from Govan to Port Glasgow Bank, *Miller*, 502.—Evidence as to delays from want of water in the river, *ib.*

Improvements Effected and in Progress:—

The contract for the new harbour designed by Locke, now in progress, was taken at 90,000*l.*, *Gray*, 493; *Martin*, 502.—The increased accommodation will be 6½ acres, *Shamon*, 494.—The width at the entrance will be 150 feet, which is sufficient, *ib.*—The depth will be nearly 14 feet at low water, and this depth can be maintained at very little expense, *ib.*—At this depth all ordinary sized vessels will be almost entirely water-borne at all times, *ib.* 495.—The large deep-sea steamers will be berthed at the mouth of the new harbours, where they can sail at all hours, *ib.*—Approves entirely of the works now going on, *ib.*—If executed as at present proposed, they will afford better accommodation than a wet dock, *ib.*—Approves of the present works, which are most suitable for the timber trade, *Hamlin*, 499.—Thinks it judicious to make and retain a depth of 14 feet, *ib.*—The retaining wall westward of the present harbours, now in course of erection, will extend to 150 feet beyond low-water mark, and cost about 11,000*l.*, *Gray*, 493; *Martin*, 502.—Thinks the additional works now in progress much wanted, *Hamlin*, 499.—They will be sufficient for the present trade of the port, but if the trade increases still more, as is expected, from the development of the railway traffic, another harbour must be built, *ib.*; *Miller*, 502.—It is intended to form a space of three acres for timber, deals, &c., and to construct quays where vessels drawing 16 feet of water can discharge timber, &c., *Allison*, 502.—Evidence relative to the railways and railway pier about to be erected eastward of Greenock, *Tasker*, 500, 501.—These intended for the shipment of minerals, *ib.*—The pier is to be in a line with the river wall, *ib.*

Improvements Suggested:—

Breakwater.—Power has been taken under the last Improvement Act to construct a breakwater, *Shannon*, 494.—Thinks the erection of a breakwater at Gervel or Gemmel's Point would be apt to turn the channel and send the water over to the other side of the bank, *ib.* 496; *Allen*, 496.—Approves of a breakwater on the bank, which would enable vessels to lie as quietly at all times in the roadstead as in the harbour, *Miller*, 502.—Does not think the breakwater necessary, nor worth the expense it would cost, *Shannon*, 494.—It might do good by saving the outside of the harbours, especially in high tides and easterly gales.

Wet Dock and Tidal Harbour.—Believes that a wet dock would be more generally acceptable to the shipmasters than a tidal harbour, *Allen*, 496.—Wet dock not necessary, as ordinary-sized vessels will be almost always afloat in 13 or 14 feet at low water, *Hunter*, 501.—A tidal harbour at the east end with a wet dock and tidal basin at the west end of the bay of Quick will afford the best accommodation for the increased traffic expected by the railways, *Hamlyn*, 499.

Complaints:—

Numerous representations have been made by shipowners of the want of sufficient accommodation, *Gray*, 494; *Allen*, 496; *Miller*, 502.—A memorial lately received on this subject, *Gray*, 494.—The subject of further accommodation remitted to Harbour Accommodation Committee, who have reported to the Trust in favour of improvement, *ib.*—The additional harbour and works now in progress evince their opinion of the necessity for further accommodation, *ib.*—When harbour master received repeated complaints of insufficient accommodation for the trade of the port, *Shannon*, 494.—The complaints related chiefly to the inferiority and insufficiency of accommodation afforded to vessels of large tonnage, *Baine*, 499.—Ships not being kept afloat or nearly water-borne, a source of frequent complaints, *Shannon*, 494.—Has heard of these complaints but never knew any vessels damaged from this cause, *Cumming*, 498.—Committee of Inquiry appointed in consequence of the number of complaints of want of accommodation, *Baine*, 499.—Extract of Report of Committee in favour of constructing a tidal harbour, pointing out the most suitable site, *ib.*—The Committee unanimous in their recommendation and the trustees unanimous in their approval of the recommendations contained in the Report, *Baine*, 500.—Excessive expenditure of the Trust moneys for law and Parliamentary expenses generally complained of, *ib.* 502; *Martin*, 502.—The last Harbour Act cost 3000*l.*, principally from the opposition of the Glasgow trustees, *Martin*, 502.—The defenceless state of the port complained of, *Anderson*, 502.—The Chamber of Commerce have petitioned the Admiralty Board on the subject, but no proceedings have been taken in reply to their application beyond referring it to the Board of Ordnance, *ib.*

Reports of Engineers, &c.:—

On the projected wet docks at Bay of Quick, *Rennie*, 1802, 503.

Miscellaneous Papers:—

Titles of the Acts of Parliament and Charters relating to the harbours, 503.—Letter from Mr. Thom, of April, 1835, enclosing estimate of the docks referred to in Telford's plan, 506.—Letter from Mr. Stewart, of June, 1835, offering ground for docks, 507.—Report of the Committee on the Harbours, 1835, 507.—Report of Committee on extension of the harbours, 1841, 509.—Memorial of deep-sea pilots to the Tidal Harbours Commissioners, 1846, 515.—Account of revenue, expenditure, and debt, from 1841 to 1846, 516.—Schedule of bay anchorage dues, 516.—Return of income and expenditure in 1841, 1842, and 1843, 517.

GOUROCK:

The power to levy small customs, shore dues, &c. granted by charter of 1694 to the then proprietor of Gourock and his successors, *Darroch*, 517.—The present pier is within the harbour, and was erected, with the consent of the proprietor, by a joint stock company, incorporated by 5 and 6 Will. IV., cap. 78, *ib.* 517.—The pier is used by vessels engaged in the herring and cod fisheries, and in white fishing, and in exports of paving stones and dressed free-stone; and imports of coal, lime, slate, &c., for the surrounding country, *ib.*—Complaints have been made of a shoal on the north-west of the pier, *ib.*, Rep. liii.

Income, Expenditure, and Debt:—

Income.—In 1842, 296*l.* 12*s.* 10*d.*; 1843, 257*l.* 4*s.* 4*d.*; 1844, 624*l.* 6*s.* 2*d.*, *Darroch*, 517; for 1845-6, see p. 656.

Expenditure.—In 1842, 234*l.* 2*s.* 10*d.*; 1843, 228*l.* 9*s.* 9*d.*; 1844, 577*l.* 9*s.* 0½*d.*, *Darroch*, 517.

Debt.—Amount due 1st January, 1846, 2000*l.*, *Darroch*, 517.

HARBOURS:—

Want of—St. Abb's Head, Rep. xix.—On the coast between Fifeness and Queensferry, *ib.* xxvi.—From Cromarty to the Tay, *ib.* xxxiv.—From *Cromarty* to *Long Hope* in the Orkneys, *ib.* xl.

Number of—There are 140 harbours in Scotland, exclusive of those on the west coast of Sutherlandshire, of the Hebrides, Orkney, and Shetland Isles, Rep. xvii.

HARBOURS OF REFUGE:—

Description of sites suggested for Dunbar, Rep. xix.—Eyemouth, *ib.* xix.—Peterhead, *ib.* xxxiii.

HEBRIDES:

Description of these islands, Rep. xliii.—Number of vessels and tonnage passing, and account of lights, *ib.*

HELMSDALE:

One of the most thriving fishing stations on the east

HELMSDALE—continued :—

coast of Scotland, Rep. xxxix.—The entrance is between two shingle points, marked by a fairway buoy, with several beacons to point out the channel, *ib.*—The bar has usually a depth of 14 feet of water over it, and 10 feet up to the quays at high water springs, *ib.*—The eastern side of the river is formed into a quay 100 yards long, *ib.*—And a wharf wall from the bridge partly shelters an inner basin, *ib.*—The arrivals in 1846 were 91 vessels of 4177 tons, *ib.*—220 boats fishing from here in the season. and great complaints are made of want of sufficient accommodation, *ib.*—It is the head-quarters of a fishing district, extending from Dornoch to Dunbeath, a distance of 35 miles, employing 760 men and boys, *ib.*—Return to Order of the House of Commons of 1844, 359.—Leslie, on improving the harbour, with estimates, 1839, *ib.*

Income and Expenditure:—

Income.—In 1841, 210*l.* 2*s.* 9*d.* ; 1842, 233*l.* 2*s.* 11*d* ; 1843, 226*l.* 1*s.* 6*d*, *Gunn*, 361 ; for 1844-5-6, see p. 658.

Expenditure.—In 1841, 883*l.* 1*s.* 3*d.* ; 1842, 85*l.* 15*s.* 4*d.* ; 1843, 142*l.* 1*s.* 6*d.*, *Gunn*, 361.

HIGHLAND ROADS AND BRIDGES :—

Commissioners of—Account of moneys expended for harbours. canals, &c., of Scotland, between 1807 and 1824, Supp. 653.

INCOME AND EXPENDITURE OF SCOTTISH PORTS :—

Aggregate income of all the Scottish ports, 192,000*l.* a-year, Rep. xvii.—Account of the dues levied on goods and on shipping in each port in Scotland in the years 1844, 1845, and 1846, Supp. 654-659.

INVERGORDON AND INVERBRECHIE:

On the north shore of Cromarty Firth, has a good pier, 133 yards long, with a depth of 14 feet at high water springs, and a projecting timber jetty for steamers, Rep. xxxviii.—A ferry is established here to Inverbrechie, across the firth, where there is a similar pier, 90 yards long, *ib.*—The two piers together cost 1638*l.*, *ib.*

INVERARY:

Description of the harbour, Rep. xlvii.—Return to Order of the House of Commons of 1844, 380.

Income and Expenditure:—

Income.—In 1842, 59*l.* ; 1843, 57*l.* ; 1844, 69*l.* 4*s.*, *Wright*, 381 ; for 1845-6, see p. 656.

Expenditure.—No account can be furnished, as the dues have been appropriated to the general expenditure of the burgh, *Wright*, 381.

INVERKEITHING:

Has an inner and outer harbour, Rep. xxiii.—The entrance to the outer bay is between piers 500 feet apart; many vessels take shelter in this harbour in easterly gales, *ib.*—The inner harbour has berthage for ships of 12 or 13 feet draft at spring tides, *ib.*—The arrivals and sailings in 1846 were 864 vessels of 67,540 tons; of these 239 vessels were either foreign or colonial, *ib.*—The revenue in 1846 was 352*l.*, and the debt 2465*l.* ; for income and debt in 1844-5-6, see p. 654.—The proprietor of this harbour declines to furnish any information respecting it, 154.—Correspondence on the subject, 184.

INVERNESS:

Present Condition of Harbour:—

The harbour consists of the sea reach of the Ness, and with the exception of Thornbush Quay and the small dock near the town, remains almost in its natural state, Rep. xxxvi.—It has a 14 feet rise of tide, and many advantages which have not been improved. *ib.*—The Thornbush, or Steam-boat Pier, was built at different periods, but much extended in 1838, *Mactavish*, 347.—None of the improvements authorized by the governing Act, as deepening, scouring, and cleansing the harbour, have lately been attended to, excepting to a limited extent alongside Thornbush Quay, *ib.*—This pier is of great use to the town, as it can now keep a vessel of 8 or 9 ft. draft afloat at low water, *ib.*—It is difficult to bring up a ship when the river is high, *ib.*—The river brings down some stones, but trifling in quantity, *ib.* 347-8.—The only gravel deposits are from the Burn of Holm, *ib.* 348; *Nicol*, 351.—The habit of throwing earth into the river from houses in progress of building, has been discontinued, *Mactavish*, 347.—Since 1810 there has been little difference in the bed of the river, *ib.*—Not much difference in the quantity of water, *Cameron*, 348 ; *Paterson*, 351.—Very little change in the river for the last 24 years, *Sharp*, 350.—There are six weirs on the river, which are of much service in impeding mud, gravel, &c., from reaching its mouth, *Mactavish*, 347.—The Ness has a fall of about 40 ft. in seven or eight miles, *ib.*—A vessel drawing 12 ft. can enter the sea-lock of the Caledonian Canal at quarter flood, *ib.* 348 ; *Sharp*, *ib.*—Vessels drawing 8 ft. water can pass over the sea-lock sill at low water, *ib.* ; *Paterson*, 351.—The Ness is very gentle and tractable, and offers no obstacles to improvements, *Mactavish*, 348 ; *Nicol*, 351—Statements as to the alarm created by the great increase of water in Loch Ness during floods, and the quantity escaping at these times by the wide outlet, to the danger of the town and country, *Mackay*, *ib* ; *Mactavish*, *ib.*—The old bridge was built in 1681, and the new one in 1807, *ib.*—Some parts of the bar have become a little shallower, *Cameron*, 348-9.—There is no bar on the river but the scalps. No stones are carried so far down as the river's mouth, but there are a great many between the Steam-boat and new piers, *ib.* 349.—In some places, at the entrance of the canal, mud, &c., have gathered to the height of four or five feet, but these have not proceeded from the canal, *ib.*—The material of the Mussel Scalp at the river's mouth is hard gravel and tough clay. *ib.*—The mouth of the canal was filled up gradually, and has only once been cleared out, *ib.*—Banks of mud, &c., have been dredged from the mouth of the canal, *Sharp*, 350 ; *Paterson*, 351.—A north-west wind is the worst for a vessel lying at Thornbush Quay, *Cameron*, 349.—The quays of the dock are in a tolerably good state, *ib.*—There is no tide-scale in the Ness, but there are figures marked on the New quay indicating the depth, *ib.*—The canal basin is of great benefit to the town. *Sharp*, 350 ; *Lawrence*, *ib.*—There is great difficulty in entering the canal during a heavy north-west wind, *Sharp*, 350 ; *Lawrence*, *ib.*—The foundation of the river harbour is much better than that of the canal, *Sharp*, 350.—Kessock Ferry Quay was built in 1825-6, by Sir W. Fettes, and now belongs to Col. Baillie, *Mactavish*, 350.—It is a great accommodation to the ferry, but evidently injurious to the harbour, and built on the best mooring and holding ground belonging to the port, *ib.* 350-1.

Tides.—The tide reaches the quay at quarter flood, and rises three feet less than at the river's mouth, *Cameron*, 349.—It extends about half a mile above the Old Bridge, *ib.*

Lights, Buoys, and Beacons.—There is no difference in light dues by going through the canal as when witness has gone through there were no lighthouses, *Cameron*, 349.—Has seen vessels run on Chanonry Point from want of a light, *ib.*; *Sharp*, 350.—The light on this Point, erected on 25 May, 1840, is of great use, but the Cromarty Light is only seen when passing it, *ib.*—There are no buoys nor beacons to point out shoals in the Moray Firth, *Cameron*, 349 ; *Sharp*, 350 ; *Commissioner*, *ib.* ; *Lawrence*, *ib.* ; *Paterson*, 351.—The approaches to the harbour require buoys and beacons, *ib.*—These have since been placed, 350, *Note.*—There are seven warping posts in the river, but mostly decayed, *Paterson*, 351.—They serve for beacons as well as for warping, but though useful, are very inconvenient, *ib.*

Pilots.—The pilots are directed by the harbour-master where to moor vessels, and they see that they are moored, *Cameron*, 349.—Witness, a pilot, served an apprenticeship with his father, but passed no examination, *Paterson*, 351.—There are four pilots, two for Inverness, and two for Beauly, *ib.*

Management:—

The port is constituted by ancient royal charters ratified by Acts of Parliament, under which the old dues were created. An Act was obtained, in 1808, for improving the harbour, which authorized additional dues, *Mactavish*, 347.—Extent of shore subject to dues is from Carnlaw to Clachnaharry. *ib.*—The Town Council, twenty-one in number, have always had the government of the port, and there is a harbour committee formed by them, several of whom are well acquainted with these matters, and there are and have been generally some shipowners

INVERNESS—continued:

Management—continued:—

and captains in the Council, *ib.*—Mr. Mitchell, engineer, has been employed to superintend repairs, and Mr. Morrison, surveyor, to make plans of the river and harbour, *ib.*—In 1842, the Council proposed to obtain an Act, but difference of opinion as to the plans prevented this, *ib.*—There is a feeling that there should be a special harbour trust, *ib.*—There has been a rapid improvement in trade, and were it not for the canal the Council would be quite able to make the harbour themselves, *ib.*

Income, Expenditure, and Debt:—

The old dues exacted under Acts and Charters passed and granted prior to 1808 were fixed, in 1816, at 332*l.* per annum, the average for the three preceding years, *Mactavish*, 347.—The old and new dues are collected together, the former being paid to the town, and the latter, authorized by the Act of 1808, are expended in improvements and in liquidation of the debt due by the harbour to the town, *ib.*—The debt is at present less than 4,000*l.*, exclusive of the annual payment of the 332*l.*, *ib.*—The fund derived from the harbour in anchorage and shore dues amounted last year to 1,180*l.* *ib.*—Statement of the revenue and expenditure of the harbour from 1808 to 1846, *ib.* 348.—The harbour dues are rapidly increasing, there being an increase of 335*l.* on the income of the previous year, *ib.*—Total revenue for the last 34 years, 20,129*l.*, and expenditure for the same period, 6,034*l.* 11*s.* 8*d.*, exclusive of the 332*l.* for old dues and interest of debt since 1816, *ib.*—Account of income and expenditure in the years 1842 3, and 1844, 357; for income for 1844-5-6, see p. 656.

Shipwrecks and Lesser Damage:—

Never knew an instance of a vessel dragging her anchor at the pier, or being wrecked, *Cameron*, 349.—Never knew damage to the amount of 1*l.* done to a vessel at the pier, *ib.*—Would go round the Pentland Frith rather than through the canal, on account of damage sustained from want of attendance and scarcity of hands at the latter, *ib.*—Vessels have run on Chanonry Point, and on shore, from want of a light, *ib.*; *Sharp*, 350; *Paterson*, 351.

Shipping and Tonnage:—

The arrivals and sailings of vessels are about 400 a-year, the increase being at the rate of 100 per annum for the last three years, *Cameron*, 349.—415 vessels entered the harbour in 1845; total tonnage about 40,000, of which six foreign were of 1,000 tons, *Cumming*, *ib.*—No weather-bound vessels ever come, *ib.*—No account kept of the vessels which have passed through the canal, *ib.*—There are 225 vessels belonging to the port, but many very small, and there are 800 registered seamen for these, *ib.*—Few fishermen belong to the town, but a great many to the district, *ib.*—The exports are generally timber, wool, grain, cattle, &c., and the imports, coal, lime, salt, manufactured goods, wine, &c., *ib.*—The traffic of the port has considerably increased, notwithstanding the best interests of the harbour have been entirely neglected, Rep. xxxvi.

Plans and Surveys:—

Plans of the river, harbour, &c., executed in 1842, by Mr. Morrison, surveyor, are in the hands of the Town Council, *Mactavish*, 347.—No plan of the river so far up as Holm Burn, except that of 1794, belonging to the town, *ib.* 348.

Improvements Effected and in Progress:—

Thornbush Pier has been enlarged by the Town Council, so as to admit steam-boats, *Mactavish*, 347.—But few improvements have been attended to lately except deepening and scouring, to a limited extent, alongside this quay, *ib.*—The channel of the Caledonian Canal sea lock has lately been deepened, but previously vessels could not be taken up at low water, *Sharp*, 348, 350.—The harbour has been much improved in the last 45 years, *Cameron*, 349.—The water has been deepened towards the north by order of the Canal Commissioners, *ib.*—The buoys and beacons recommended by the Commissioners have been placed, 350, *Note.*—Does not contemplate a great increase of trade from the present improvements on the canal, *Sharp*, 350.—There are piles of stones and a wooden jetty now erected at the canal mouth, so that a vessel can be taken in more easily than formerly, *Paterson*, 351.

INVERNESS—continued:

Improvements Suggested:—

There should be a special harbour trust, *Mactavish*, 357.—The Improvement of the harbour would be of immense advantage to the town, *ib.*; *Nicol*, 391; *Cumming*, 349; *Lawrence*, 350.—There should be a new Bill and a separate Board of Management, *Mactavish*, 347.—A new harbour is required, *ib.* 348; *Sharp*, 350.—A straight course from the Kessock Ferry would be the best entrance into the harbour, *Cameron*, 349; *Lawrence*, 350.—The new entrance should be somewhat to the east of the present channel, *Sharp*, 350.—The new channel should have 10 ft. at low-water, *Lawrence*, 350.—This would be very awkward in a south wind, *Paterson*, 351.—A new channel unconnected with the river, and an embankment, *Nicol*, 351.—There should be a dock between Thornbush and the quays, *Cameron*, 349.—There should be a dry dock formed about the site of the present new pier, *Sharp*, 350.—The ford of the river should be cleared of the stones that lie there, *Cameron*, 349.—Tide scales should be erected in the harbour immediately, *Commissioner*, 349; *Vetch*, 351.—Buoys and beacons are required to point out the shoals in the Moray Frith and the approaches to the harbour, *Cameron*, *ib.*; *Sharp*, 350; *Commissioner*, 350; *Lawrence*, *ib.*; *Paterson*, 351.—The places where buoys and a large beacon should be placed, described, *Cameron*, 349; *Sharp*, 350; *Lawrence*, *ib.*; *Paterson*, 351.—Statement that the accommodation afforded by the Caledonian Canal basin and wharfs renders new erections unnecessary, *Cumming*, 349.—Objections to doing away with the harbour and substituting for it the basin of the canal, *Mactavish*, 349, 350.—To obviate the difficulty of entering the canal, in a north-west wind, a tidal basin or breakwater would be of service, *Sharp*, 350; *Lawrence*, *ib.*; *Paterson*, 351.—The unsuitableness of the foundation would render it difficult to make, *Sharp*, 350.—An embankment in Newton Bay would be advantageous, *Sharp*, *ib.*; *Commissioner*, *ib.*—In case of a high east wind, a cut from the sea to the Thornbush Pier would be highly useful, *Sharp*, *ib.*—An equalization of the dues would be a good measure, *Mactavish*, 351.—The free use of the dredging machine recommended, *Commissioner*, *ib.*

Complaints:—

Within the last 20 years many complaints have been made of the want of harbour accommodation, and in consequence many vessels have gone to the canal, *Mactavish*, 347.—There has been but one written complaint as to the accumulation of stones at Thornbush Pier which endangered ships, but it was attended to and remedied, *ib.*—The Kessock Ferry Quay is injurious to the harbour, *ib.* 350.—The improvement of the harbour has been most culpably neglected, from want of enterprize among the citizens, *Nicol*, 351, Rep. xxxvi.—Complaints have been made of the utter want of buoys and beacons in the approaches to the port, Rep. xxxvii.

Miscellaneous Papers:—

Return to Order of the House of Commons of 1844, 351.—Statement of the rights of the Burgh by charters, &c., 352.—Leslie, on the proposed steamboat pier, and estimate, 5 Dec., 1834, 354.—Opinion of counsel as to the right of the Burgh to levy dues within certain limits, 3 June, 1846, 355.—Stevenson and Maynard, on proposed improvements, 1847, *ib.*—Admiralty Report on the Harbour and Navigation Improvement Bill, 1847, 357.—Return of income and expenditure for 1842-3 and 1844, *ib.*

IRVINE:

Description of the harbour, Rep. lv.—Return to Order of the House of Commons of 1844, 535.—Smith, on improving the harbour and forming a dock, 1826, 536.—Gibb, on improving the harbour, and estimate, 1839, 537.

Income, Expenditure, and Debt:—

Income.—In 1842, 418*l.* 1*s.* 1½*d.*; 1843, 359*l.* 17*s.* 5*d.*; 1844, 420*l.* 2*s.* 9½*d.*, 538; for 1845-6, see p. 656.—The dues are levied under the Act 3 Geo. IV. c. 91, 538.

Expenditure.—In 1842, 539*l.* 9*s.* 4½*d.*; 1843, 702*l.* 1*s.* 8½*d.*; 1844, 436*l.* 16*s.* 7*d.*, 538.

Debt.—1072*l.*, due 1st January, 1846, 338.

ISLAY:

Description of the ports, Rep. xliv.—M'Lean, on throwing ballast into the harbour, Oct., 1846, 628.

JOHNSHAVEN:

A proprietary harbour; the dues levied under the authority of a charter, 260.

Income.—In 1841 the income amounted to 43*l.* 3*s.* 10*d.*; in 1842 to 38*l.* 14*s.* 11*d.*; and in 1843 to 46*l.* 4*s.* 5*d.*, 260.

Expenditure.—In 1842 the expenditure amounted to 3*l.* 3*s.* 8*d.*; in 1843 to 2*l.* 15*s.* 3*d.*; and in 1844 to 10*l.* 1*s.* 11*d.*, 260.

JURA:

Description of the harbours, Rep. xliv.

KEISS:

Is sheltered by a breakwater pier, completed in 1833, at an expense of 1600*l.*, two-thirds of which were paid by the Fishery Board, Rep. xli.—The area of outer and inner harbours not more than three quarters of an acre; the entrance 35 feet, with a depth of 8 feet at the pier heads at high water, *ib.*—It is the head-quarters of 40 fishing boats, *ib.*

KILMORY QUAY (LOCH GILPHEAD):

The quay was built in 1813 by the late proprietor, at his own expense, for the accommodation of his tenants and fishermen, *Orde*, 380. It cost between 400*l.* and 500*l.*, *ib.*—The dues formerly let by auction, but are now collected by the proprietor, *ib.*—They were let in 1840 for 9*l.* 1*s.*, *ib.*—No account has been kept of the expenditure, it being principally done by the owner's own workmen, supplying also the timber and stone from his own plantations and quarries, *ib.*—Revenue in 1844, 10*l.* 3*s.*; 1845, 10*l.*; and in 1846, 7*l.* 6*s.*, Supp. 656-7.—The quay is accessible only at high water, as the tide ebbs nearly a mile beyond it, *ib.*—It has an average depth of six feet of water, and is quite sheltered, *ib.*—If adequate power were given to enforce the collection of dues, it would be easy to straighten and deepen the bed of the river so as to render it much more useful, and even accessible for steam-boats, *ib.*—The present proprietor contemplates removing the quay altogether, *ib.*, Rep. xlvi.

KILRENNY. (*See* CELLARDYKE.)

KINCARDINE:

The pier at this place was built by Lord Keith in 1811-1813, under the authority of an Act passed in 1810, *Menzies*, 153.—It is a low-water pier or slip, 239 yards long, extending into 6 feet at low water, with a quay, Rep. xxiii.—On the south shore is an embankment 186 yards and a timber jetty 256 yards long, narrowing the river at this place to a width of 426 yards only, *ib.*—The two piers together cost 6468*l.*, *ib.*—Lord Keith's trustees are the present proprietors, *ib.*—There is neither map, plan, nor report of engineer on the harbour, *Menzies*, 153.—No complaints have been made relative to any defect connected with it, *ib.*—The average annual income of the last three years, from anchorage and shore dues, amounted to 20*l.*; the expenditure for repairs, &c., 5*l.*, *Menzies*, 153, 654, 655.—The dues are collected under 50 Geo. III., c. 29, *ib.*—The arrivals in 1846 were 64 vessels of 3160 tons, Rep. xxiii.

Embankments:—

Immediately above and below Kincardine, 366 acres of the alveus of the river have been embanked without the sanction or knowledge of the Admiralty, Rep. xxiii.—This embankment in itself not prejudicial to the navigation, but illustrative merely of the utter indifference manifested by all parties to the rights of the public and the improvement of the navigation, *ib.*—Detailed description of both embankments, *ib.*—An Act of Parliament has been obtained, (1 and 2 Will. IV., c. 3), authorizing much more extensive embankment in this neighbourhood on the south side of the Firth, Rep. *ib.*—700 acres of the alveus will be shortly enclosed from the south ferry of Kincardine to the mouth of the Carron, *ib.*—600 acres further eastward to the entrance of the Avon, and about 600 more acres from thence to Borrowstowness, *ib.*—Some of these works have already been commenced, but none have been submitted to, nor sanctioned by the Admiralty, *ib.*—Further observations on embankments, showing that works of this description should not be allowed to be carried on without the sanction of the Admiralty, or some superior board, competent to decide upon the damage, or otherwise, to navigation likely to arise, *ib.*

KINGHORN:

The pier is in ruins, and the harbour sanded up, and not used for any purpose, Rep. xxiv.—It is barely six feet deep at high water, *ib.*

KIRKCALDY:

Has an area of four acres, including a half-tide basin, enclosed by piers, Rep. xxiv.—The outer entrance is 61 feet wide, and 14 feet deep at the pier heads, Rep. xxiv.—The entrance to the gates is 32 feet wide, and 6 feet deep within the gates, *ib.*—The east quay has been recently extended 250 feet, which has greatly lessened the violence of the sea in the harbour, *ib.*—The east quay has been extended 300 feet, instead of 250 feet, as recommended by Leslie, *Russell*, 155.—This extension cost upwards of 10,000*l.*, *ib.*—This has made the harbour much quieter in easterly gales, Rep. xxiv.—The remainder of Leslie's plan of improvements will be carried out when the revenue admits of it, *ib.*—The arrivals in 1846 were 646 vessels, of 32,264 tons, of which 76 vessels were either foreign or colonial, Rep. xxiv.

Management:—

The harbour is under the control of Commissioners under the Act of 1829, Rep. xxxiii.

Income, Expenditure, and Debt:—

Income.—In 1842, 1642*l.* 1*s.* 2*d.*: 1843, 1435*l.* 6*s.* 6½*d.*; 1844, 1497*l.* 14*s.* 3*d.*, *Ronald*, 158.

Expenditure.—In 1842, 322*l.* 9*s.* 7½*d.*; in 1843, 299*l.* 12*s.* 10*d.*; 1844, 441*l.* 13*s.* 8½*d.*, *Ronald*, 158.

Debt.—9963*l.*, due 31st December, 1845, *Ronald*, 158.

Reports of Engineers, &c.:—

Leslie, on improving the harbour and forming docks, &c., 1839, 156.

KIRKCUDBRIGHT:

Description of the harbour, Rep. lviii.—Return to Order of the House of Commons of 1844, 597.

Income and Expenditure:—

Income.—In 1841, 26*l.* 17*s.* 7*d.*; 1842, 33*l.* 4*s.* 7*d.*; 1843, 33*l.* 18*s.* 1*d.*, *M'Adam*, 597; for 1844-5-6, see p. 654.—The dues are collected under the charter of James II. [1455], confirmed by Act of Charles I. [1633], *M'Adam*, 597.

Expenditure.—In 1841, 23*l.* 7*s.*; 1842, 41*l.* 10*s.*; 1843, 16*l.* 14*s.* 10*d.*, *M'Adam*, 597.

KIRKWALL, ORKNEY:

Is sheltered from the northward by a pier, 120 yards from the shore, with a return head of 33 yards, bearing north-west, built at a cost of 3944*l.*, half of which was defrayed out of the forfeited estates, Rep. xli.—It is managed by trustees, under the Act 9 Geo. IV., c. 58, who have power to levy dues for the enlargement of the harbour, *ib.*—Power is required to prevent ballast and rubbish being thrown into the harbour, which here, and at other ports in the Orkneys, is commonly done, *ib.*—A summary mode of dealing with offenders the only safeguard against ruin of the harbours, and the only efficient remedy for this destructive practice, *ib.*—Return to Order of the House of Commons of 1844, 373.

Income, Expenditure, and Debt:—

Income.—In 1841, 120*l.*; 1842, 146*l.*; 1843, 156*l.*; for 1844-5-6, see p. 658.—The dues are levied under 9 Geo. IV. c. 58, 374.

Expenditure.—In 1841, 120*l.*; 1842, 146*l.*; 1843, 156*l.*, 374.

Debts.—779*l.*, due 1st January, 1846, 374.

LARGO:

At the mouth of the Keilburn, has an eastern pier, and westward, the natural ledge of rock, called the pier of Lundin, Rep. xxv.—The entrance is 56 feet wide; within the elbow of the east pier there is berthage for four vessels, drawing 9 or 10 feet of water, on a clay bottom, *ib.*—The arrivals, in 1846, were 60 vessels, and the revenue amounted to 40*l.*, *ib.*

LARGS:

Description of the harbour, Rep. liii.—Return to Order of the House of Commons of Aug., 1844, 518.

Income and Expenditure:—

Income.—In 1841-2, 279*l.* 4*s.* 6½*d.*; 1842-3, 283*l.* 5*s.* 9½*d.*; 1843-4, 314*l.* 2*s.* 10*d.*, *Campbell*, 518, for 1845-6, see p. 656.—The dues are levied under the Act 2 Will. IV. c. 44, *Campbell*, 518.

LARGS—continued:

Income and Expenditure—continued:—

Expenditure.—In 1841-2, 83*l.* 17*s.* 10½*d.*; 1842-3, 86*l.* 19*s.* 1½*d.*; 1843-4, 76*l.* 18*s.* 2*d.*, *Campbell*, 518.

LEITH:

Present Condition of Harbour.—

The harbour is formed by the outlet of the water of Leith, guided by an eastern pier across an extensive foreshore of flat sand, Rep. xvii.—The pier is 833 yards long, reaching out to low-water mark, *ib.*—Eastern pier too slight for traffic, Rep. xvii.—Although upwards of a quarter of a million of money has been expended on the works, there is still great want of accommodation, and the entrance to the harbour at low tides is almost dry, *ib.*—Further description of the harbour, *Stevenson*, 36; *Cubitt*, 42.—The depth of water at ordinary neap tides at the entrance is between 8 and 9 feet, at spring tides between 13 and 14 feet, *Stevenson*, 36.—Observations on the set of the tides, *ib.* 37.—Existing dock accommodation very defective, and insufficient for the trade of the port, *Leslie*, 2; *Dall*, 3; *Dowie*, 3.—There is neither patent slip, graving dock for steamers, or low-water jetty, accommodation altogether still very deficient, Rep. xvii.—Vessels lie five a-breast by the quays, *ib.*—Has known large vessels lying in the roads for a week before they could get into the harbour, even by lightening their cargoes, *Dowie*, 3.—The entire length of the east pier is 2500 feet, *Leslie*, 2.—Low-water mark not altered by the erection of the piers, *ib.* 3.—The works at Newhaven and Granton have not affected Leith harbour, *ib.* 2.—Depth of water increased in Leith harbour; vessels now come in drawing 2½ feet more water than formerly, *ib.* 3. Rep. xvii. xviii.

Pilotage.—There are 100 licensed harbour pilots at Leith, and 60 sea pilots, *Smith*, 4.—The harbour pilots receive their licences from the Dock Commission after examination by the Trinity Board, *ib.* 4.—Complaints have frequently been made against the pilots, *ib.* 4.—A better class of men much wanted, *ib.* 4.—The Pilot Act is deficient, *ib.* 4.

The Bar.—There is no proper bar across the harbour, but a sort of inclined plane, *Leslie*, 3.—Witness, in opposition to Mr. Leslie's opinion, maintains that that there is a bar, *Arrow*, 3.—This bar is formed partly by the sea and partly by the silt brought down the river, *ib.* 3.—The appearance of a bar is caused by dredging and deepening inside, and not by shoaling outside. *Leslie*, 3; *Stevenson*, 37.

Obstructions.—The flow of the tide stopped by the weir at Leith Mills, *Leslie*, 2.—By removing this weir the tide would flow up half a mile farther than at present, *ib.* 2.

Lights.—The coast lights generally are brilliant and efficient, but are not sufficient in number, *Dall*, 3.—The light dues complained of as very heavy, *Dowie*, 4

Dredging.—Dredging is carried on in summer. The dredge was purchased in 1827, at a cost of 7000*l.*; it is of 16-horse power, *Dall*, 3.—It cuts both sideways and forwards; the dredging frame is 32 feet long, with 30 buckets, *ib.* 3.—It can lift about 30 tons an hour, *ib.* 3.—Can begin working when the dredge floats in 6½ feet, and can work to a depth of 15 feet, *ib.* 3.—There are 30 punts, *ib.* 3.—Dredging costs about 10*d.* a ton, or about 2000*l.* a-year, *ib.* 3.—The average quantity of silt brought down the river not more than 6 inches in a year, *Leslie*, 2. — About 6 inches in the docks and 9 inches in the harbour, *Dall*, 3.—The soil dredged up is deposited to the eastward of the pier, *ib.* 3.—About 30,000 cubic yards of 65,000 tons are raised in the year, *ib.* 3.

ncome, Expenditure, and Debt:—

Income.—The income is derived from dock dues, shore dues, berthage, anchorage, &c. The total amount of revenue derived from all these sources in 1845 amounted to 27,945*l.*, being a very large increase over the year preceding, *Sandeman*, 2. The increase of revenue chiefly caused by the importation of corn, *ib.* 2.—The dues on shipping are high, on goods low, *ib.* 2.—Revision of duties necessary, as some goods worth only 20*l.* are charged 3*s.* 6*d.*, while goods of a different description worth 100*l.* are charged only 5*d.*, *Phin*, 2.—The cost of collection amounts to 2¼ per cent. on the sum collected, *Sandeman*, 2.—Account of the revenue in each year, from 1829 to 1833, both inclusive, *Cubitt*, 46.—Average of these five years 22,341*l.* 2*s.* 2*d.*, *ib.* 46.—Account of income under different heads, in the years 1841-2 and 1843, 83.—Total amount in 1841, 25,716*l.* 11*s.* 10*d.*—In 1842, 22,126*l.* 15*s.* 11*d.*, and in 1843, 22,273*l.* 0*s.* 7*d.*, 83; for 1844-5-6, see p. 658.

LEITH—continued:

Income, Expenditure, and Debt—continued:—

Expenditure.—Limited to 2000*l.* per annum, *Phin*, 1.—Special sanction of Edinburgh City authorities necessary before a larger expenditure can be incurred, *ib.* 1.—Detailed account of expenditure under different heads, in the years 1841, 1842, and 1843, 83.—Total expenditure in 1841, 21,459*l.* 5*s.* 2*d.*—In 1842, 26,278*l.* 7*s.* 3½*d.*, and in 1843, 20,922*l.* 13*s.* 3*d.*, 83.—It has latterly varied between 25,000*l.* and 26,000*l.* a-year, Rep. xvii.

Debt.—228,374*l.*, due on 1st January, 1846, 83. The payment of the Government debt postponed under the Act of 1838, *Phin*, 1.—The debt to the City of Edinburgh secured by an annual payment of 7680*l.*, *ib.*

Management:—

The harbour, by the Act of 1826, ceased to be under the management of the provost and magistrates of Edinburgh, and became vested in 21 Commissioners, 9 of whom are appointed by the City of Edinburgh, 9 by the public bodies in Leith, and 3 by the Lords of the Admiralty, *Phin*, 1.—The Act of 1838, now the governing Act, *ib.* 1.—This Act secures the debt on the harbour to the Government and Town Council of Edinburgh, *ib.* 1.—By this Act the Commissioners are limited to 11, 5 of whom are appointed by the Treasury, 3 by the provost and magistrates of Edinburgh, and 3 by the civic authorities of Leith, *ib.* 1.—Members of the town councils of Edinburgh and Leith ineligible to serve as Commissioners, there is no other limitation, *ib.* 1.—Of the existing Commissioners one only is a sailor, but there are several shipowners, *ib.* 1.—The mode of electing Commissioners gives general satisfaction, *ib.*—The Commissioners meet monthly, besides at special meetings, *ib.* 1.—Under the present Act, the Commissioners are empowered to borrow a sum not exceeding 125,000*l.*, *Phin*, 1.—No part of this money had been borrowed, *ib.* 1.—The Treasury retain power to control the expenditure for public works, *ib.* 1.—The accounts are made up at the end of each year and submitted to an accountant, and eventually to the chief remembrancer for his approval, *ib.* 1.—The accounts are then printed, and copies may be had on application at the Shore Dues' Office, *ib.* 1.

Plans and Surveys:—

There is a plan and chart of the harbour and docks of Leith and the adjacent coast, corrected to 1843, and plans and reports by Walker and Cubitt, dated in 1838 and 1839, *Phin*, 4.—Besides the above there are 12 engineers' reports and plans of harbour and docks at Leith, 4.—A plan of the harbour stated to have been made in 1680, *Cubitt*, 48.

Shipping and Tonnage:—

Account of number and tonnage of vessels which entered the port of Leith in 1826, 39.—Ditto, in the year ended 7th October, 1827, *Telford*, 40.—The arrivals and sailings in 1846 were 6467 vessels of 730,194 tons, of these 1230 vessels were either foreign or colonial, Rep. xviii.—75,000 tons of shipping have arrived in 1846 more than in the previous year, *Mitchell*, 4.—Supp. 658.

Improvements, generally:—

The necessity for a deep-water entrance to the harbour channel admitted by all engineers who have been consulted as to the best means of improving the harbour, Rep. xvii.—Half measures have been the bane of the port, *ib.*—Improvements delayed by operation of the Act of 1838, which prohibits any expenditure for public works without the sanction of the Treasury, *Phin*, 3.—The engineers, Walker and Cubitt, divided in opinion as to the best mode of improving the harbour, *Phin*, 2.—A difference of opinion among the Harbour Commissioners has prevented many necessary improvements being carried out, *Phillip*, 3.—The cost of obtaining additional powers prevents improvements, *Phin*, 2.—The Commissioners desire a Bill to modify and equalize the rates on shipping and goods, *ib.* 2.—Do not go before Parliament for this purpose on account of the expense, *ib.* 2.—A private Bill without oppo-

Leith—continued:

Improvements, generally—continued:—

sition would cost between 500*l.* and 600*l.*, and, if opposed, not less than 2000*l.*, *ib.* 2.—[The proposed Conservancy Bill would remedy this evil by carrying all such Bills through Parliament without cost to the Harbour Commissioners, 2.]

Improvements Effected:—

Important improvements have been carried out under the Act of 1826, *Phin*, 1.—The east pier has been extended according to Chapman's plan, and the western breakwater erected, *ib.* 1.—Up to 1825 the total amount expended on the docks was about 300,000*l.*, *ib.* 1.—The present docks were completed in 1817, *Leslie*, 2.—No further improvements carried out till 1829, when the east pier was begun, *ib* 2.—The west breakwater, a most useful work, built by Government, *ib.* 2.—The harbour has been deepened by dredging about 3½ feet since 1826, *Dale*, 3.—Observations on the nature of the improvements which have been carried out, Rep. xviii.

Improvements Suggested:—

A patent slip and graving-dock much wanted, steamers and other large vessels are now taken at great expense to Dundee and other places to be repaired, *Leslie*, 2; *Dowie*, 3.—All large ships repaired either at Dundee or London, *ib.* 3.—A time-ball much wanted; it might be erected on Calton-hill, and would be available to commanders of vessels for regulating their chronometers, as well as useful to the public on shore, *Arrow*, 3; *Dale*, 3, Rep. xxvi.—A further extension of the east pier 1000 feet, which would give 7½ feet at very low ebbs, *Leslie*, 2.—This would make it a low water pier, and would give nearly as much water as at Granton pier, *ib.* 2.—This extension could be easily carried out, the piles being driven well into the sand, and making the end of the pier of solid stone, *ib.* 2—This extension absolutely required for the traffic of of the port, as steamers which at low water now go to Granton would then come up at once to Leith, *ib.* 2.—The cost of these works estimated at 30,000*l.*, *ib.* 2.—By carrying out the pier 250 feet further, or 1250 feet more than at present, with a little dredging they would get 2 feet more water, *ib.* 2.—This could be done for an additional 7000*l.*, or 37,000*l.* for the 1250 feet, *ib.* 2.—The want of a low-water pier for landing passengers and light goods much felt, Rep. v.—More dock accommodation required; the present dock-gates not wide enough for steamers, which are compelled to lie aground in the bed of the river, *ib.* 2; *Dall*, 3.—Docks equal in extent to their present docks, and with 2 feet more of water, could be made for 100,000*l.*, *Leslie*, 2.—Area of proposed dock 10½ acres, with gates 55 or 60 feet wide, *ib.* 2.—The eastern pier should be extended to a depth of 12 feet at low water, *Dall*, 3.—Not less than 13 feet, *Dowie*, 3.—If accommodation could be given at Leith to enable steam passengers to land and embark within 2 hours of ebb or flow, a revenue of 5000*l.* a-year would be realized, *Dowie*, 3.—Suggestions for more extended works, Rep. xviii.—Description of the works projected under the Bill of 1847, Rep. xviii.

Conservancy Board.—The formation of this Board would cause more interference with local management than under the existing Acts, *Phin*, 1.—Such a Board would, however, be a great improvement on the present system, *ib.* 1.—It would save the large expenses now borne by the harbour funds in carrying Improvement Bills through Parliament, and also other Parliamentary and legal expenses in opposing encroachments, &c., 2.

Lights, Buoys, and Beacons.—Lights wanted on Inch Colm Inch Garvie, and at St. Abb's Head, *Dall*, 3.—There is a general complaint of want of lights, *ib.* 3.—The expenditure of 200*l.* or 300*l.* for lights in the Firth would be as beneficial as hundreds of thousands of pounds for making harbours of refuge elsewhere, *ib.* 3.—A beacon wanted off Elie Ness, where the Ben Ledi steamer got aground, *Dall* 3.

Complaints:—

The constant and well-grounded complaints of want of berthage and dock accommodation make further and more extended improvements in the harbour more urgently required than ever, *Phin*, 2, Rep. xvii. xviii.—That the dues have not been revised for 50 years, and that dues are exacted on vessels not entering the docks, Rep. xviii.—That there is no proper check upon people throwing rubbish into the river, *Leslie*, 2.—[The Examining Commissioner here intimated that there were powers in the proposed Conservancy Bill to check such a nuisance, 2.]—Rep. xviii.

Reports of Engineers, &c.:—

Report and estimates by Whitworth, on enlarging the harbour, with plans and sections, 1786, 5.—Shirreff on enlarging the harbour, with plans for basins, dry dock, &c., 1787, 9.—Rennie, on harbour and projected docks, 1799, 21.—Second Report on the same subject, 1800, 30.—Chapman on the improvement of the harbour, 1824, 33.—Stevenson's statement respecting Leith harbour, being an excerpt from a Memoir on British Harbours, 1824, 36.—Telford, on the improvement of the harbour, 40.—Cubitt, on the harbour and docks, with observations on the projected harbours and docks in the vicinity, 1834, 42.—Anderson, on the present state of the harbour, and the practicability of rendering its wet docks available by means of a deep-water entrance at Newhaven, and a communicating dock, or ship canal, 1834, 48.—Dickson, on improving the harbour, 1835, 53.—Milne, on the extension of the harbour towards the east, 1838, 54.—Cubitt's Second Report on harbour and docks, 1839, 64.—Walker, on the same subject, 1839, 66.—Milne's Second Report on the extension of the harbour towards the east, 69.—Napier's proposal for improving Leith west wet dock, 1844, 73.—Rendel, on improving the harbour and docks, 1847, 77.—Rennie, on Chapman's plan for improving the harbour, 1827, 615.—Grainger and Miller, on the formation of a wet dock at Trinity, 1835, 617.

Miscellaneous Papers:—

The Committee of inhabitants of Leith on the projected improvements, 1827, 38.—Petition of Edinburgh and Dundee Steam Packet Company to the Board of Trade on the northern lights, 1845, 74.—Mitchell's remarks on the management of the harbour, 1847, 75.—Letter from Hydrographer to the Admiralty on the want of a time ball at Leith, 1846, 81.—Report by Captains Washington and Vetch on the same subject, 1846, 81.

LERWICK:

Account of the dues of every kind levied on shipping, for 1843 and 1844, 374.—Kilgour, on the neglected state of the harbour, 1846, *ib.*—Sutherland, on the state of the harbour, 1846, 628.

LEVEN:

A small river harbour, with 12 feet over the bar at high-water springs, Rep. xxv.—This port is difficult of access, except to vessels of small draft of water, *ib.*—It is capable of considerable improvement, *ib.*—The arrivals in 1846 were, 234 vessels of 9684 tons, *ib.*

Income and Expenditure:—

Income.—In 1842, 188*l.* 6*s.* 6*d.*; 1843, 213*l.* 1*s.* 1*d.*; 1844, 158*l.* 13*s.* 6*d.*, *Christie*, 160.; for 1845-6, see p. 656.—The dues are levied under the authority of the owner, *Christie*, 160.

Expenditure.—In 1842, 324*l.* 13*s.* 2*d.*; 1843, 56*l.* 9*s.* 1½*d.*; 1844, 70*l.* 11*s.* 6*d.*, *Christie*, 160.

Lighthouses:—

Description of—*Ferry-Port-on-Craig*, Rep. xxvii.—*Bell Rock*, *ib.* xxx.—*Covesea Skerries*, *ib.* xxxv.—*Cape Wrath*, xliii.—Hebrides, *Barra Head Light*, *ib.*—*Mull of Galloway*, *ib.* lviii.

Lights:—

Want of—*St. Abb's Head*, Rep. xvii.—Thurso, *Little Head*, *ib.* xlii.—*Stromness*, *ib.* xli.—Sound of Mull, *Ardnamurchan*, *ib.* xliii.—*Corpach*, the south-western entrance into the Caledonian Canal, *ib.* xliv.—*Crinan*, *ib.* xlv.—*Mull of Kintyre, Sanda*, *ib.* xliv.—Solway Frith, *Hesban Island*, lx.—General remarks on the want of lights, *ib.* lxi.

LITTLE FERRY:

Three-quarters of a mile within the bar is good anchorage in 17 feet at low water, and perfectly safe in all winds, Rep. xxxix.—The pier on the north side is convenient and sufficient for the trade, having 9 feet at low water, but much inconvenience is experienced by the want of a similar pier on the south side, *Gunn*, 358.—At present, vessels can only be loaded or discharged at certain states of the

LITTLE FERRY—continued:—
tide, *ib.*—The pier was erected at the expense of the Duke of Sutherland, *ib.*—The bar has from 14 to 16 feet of water over it at high-water springs, Rep. xxxix.
Income and Expenditure:—
Income.—In 1841, 46*l.* 16*s.* 9*d.*; 1842, 46*l.* 8*s.* 9*d.*; 1843, 54*l.* 15*s.* 6*d.*, *Gunn*, 358; for 1844-5-6, see p. 658.—The dues are levied by consent; there is no Act, *Gunn*, 358.
Expenditure.—In 1841, 45*l.* 11*s.* 10*d.*; 1842, 35*l.* 15*s.* 5*d.*; 1843, 35*l.* 1*s.* *Gunn*, 358.

LOCH FYNE:
Description of herring fishery, Rep. xlvii.

LOCH RYAN:
Description of, lvii.—Captain Beechey's Report on Loch Ryan, 555.

LOSSIEMOUTH:
The property of a Joint Stock Company, *Duff*, 338.—The old harbour is formed by the outlet of the river which falls into a shallow bay, between stone piers, Rep. xxxv.—It is now very dilapidated, and the channel much sanded up, *ib.*—The new harbour consists of an inner and outer basin of about two acres, affording 220 yards of quayage, with a depth of 12 feet at high-water springs, *ib.*—The entrance is 60 feet wide, *ib.*—The north quay and inner basin have recently been extended at a cost of 4190, *ib.*—Observations on the conduct of the Joint Stock Company who have omitted to make the improvements specified under the Act on account of the expense, *ib.*—The arrivals and sailings in cargo in 1846 were 121 vessels of 7650 tons, *ib.*—Return to Order of the House of Commons of Aug., 1844, 337.—Letter of Mr. Allan, on the excessive rate of barbour dues, 1846, *ib.*—Lloyd's agent, on the proceedings of the Harbour Board, 1846, *ib.*—This place has no competent harbour-master; neither pilots nor warping-buoy, nor any acquainted with the requirements of sailors and shipping, Rep. xxxv.
Income, Expenditure, and Debt:—
Income.—In 1841-2, 753*l.*; in 1842-3, 852*l.*; in 1843-4, 852*l.*, *Duff*, 338: for 1844-5-6, see p. 656.—The dues are collected under the Act 4 and 5 Will. IV. c. 86, *Duff*, 338.
Expenditure.—In 1841-2, 753*l.*; 1842-3, 852*l.*; 1843-4, 852*l.*, *Duff*, 333.
Debt.—7000*l.*, due 1st January, 1846, *Duff*, 338.

LYBSTER:
A proprietary harbour.—The pier is 280 feet long, 30 feet wide, and from 16 to 27 feet high, *Sinclair*, 362.—Description of the harbour and extent of fishery, Rep. xxxix.—Several thousand pounds were expended by the late General Sinclair in making this harbour, *Sinclair*, 362.—The harbour is dry at low water, but the obstacles to its being deepened to any required extent may be removed at very trifling expense, *ib.*—The fairway is blocked up by a succession of loose but large and weighty stones, partly visible at low water; but immediately outside there is a depth of several fathoms, *ib.*—In the bottom of the present basin there is a depth of more than 16 feet of shingle, earth, and clay, *ib.*—The removal of the stones would operate to cleanse the harbour and prevent silting, *ib.*—Previous to the construction of the harbour, there were but few fishing boats at this station, the landing from the exposed situation of the shore being dangerous, *ib.*—At present there are upwards of 100 large boats annually engaged in the herring fishery, and from 20 to 30 vessels annually discharge their cargoes of salt, &c., and load cargoes of herrings at the pier, *ib.*—The pier is not yet completed to the extent projected; the work at present suspended in consequence of the large expenses already incurred upon it, *ib.*—Lybster is in the centre of a line of fishing stations, between Wick and Helmsdale, a distance of 30 miles, *ib.*—600 boats, having usually crews of five men besides boys, belong to this part of the coast, *ib.*—Evidence as to the dangerous nature of the coast, the suddenness of the storms, and the want of shelter, *ib.*—A low-water harbour, accessible to these boats at all times of the tide, the only means of affording shelter, *ib.*—Return to order of the House of Commons of 1844, 361.
Income and Expenditure:—
Income.—In 1841, 98*l.* 16*s.* 8*d.*; 1842, 106*l.* 5*s.*; 1843, 105*l.* 2*s.* 6*d.*, *Snody*, 362; for 1844-5-6, see p. 658.

LYBSTER—continued:
Income and Expenditure—continued:—
Expenditure.—In cleansing, repairing, and improving the harbour in 1841, 249*l.* 15*s.* 8*d.*; 1842, 184*l.* 14*s.* 5*d.*; 1843, 41*l.* 17*s.* 6*d.*, *Snody*, 362.

MACDUFF:
Present Condition of Harbour:—
The present harbour contains an area of 3½ acres, enclosed by stone piers, and dry at low water, Rep. xxxiv.—It has a depth of 14 feet at the pier-heads, and 11 feet at the quays, at high-water spring tides, *ib.*—The harbour is the property of the Earl of Fife, by whom it was built in 1820, *ib.*—The want of a low-water pier, accessible at all times of tide, is much felt on this part of the coast, *ib.*
Income and Expenditure:—
Income.—In 1841, 244*l.*; 1842, 231*l.*; 1843, 244*l.*, *Mortimer*, 331.
Expenditure—In 1841, 141*l.* 13*s.* 2½*d.*; 1842, 24*l.* 11*s.* 9*d.*; 1843, 12*l.* 1*s.* 8*d.*, *Mortimer*, 331.
Improvements Suggested:—
The formation of a low-water pier, by throwing out breakwater piers to enclose an area of 7 acres, with a depth of 22 feet at the pier heads at low-water springs, Rep. xxxiv.—The "Collie," a detached rock, covered at half tide, lying a quarter of a mile north-east of the pier head, should be beaconed or blasted away, *ib.*
Miscellaneous Papers:—
Bremner, on the proposed new harbour at Macduff, 1846, 333.—Admiralty Report thereon, 1847, 331.

MAIL COMMUNICATIONS:—
Defective state of—Description of mode of communicating with the Orkneys, Rep. xiii—Dornoch Firth, *ib.* xxxix.

METHILL:
This harbour has an area of 4 acres, and a depth of from 18 to 20 feet in stream tides, *Bywater*, 160.—It is enclosed by piers, with an entrance 80 feet wide and 16 feet deep at the pier-heads at spring tides. Rep. xxv.—Since January, 1838, Captain Wemyss has laid out 4990*l.* 8*s.* 3*d.*, chiefly in restoring the east pier, the west pier having previously been built, 160.—Messrs. Neilson, of Kirkland, contributed 1000*l.* of this sum, to be repaid out of the shore dues, *ib.*—The arrivals in 1846 were 190 vessels of 399 tons, Rep. xxv.
Income and Expenditure:—
Income.—In 1841, 67*l.* 1*s.* 1*d.*; 1842, 34*l.* 19*s.* 3*d.*, 1843, 21*l.* 12*s.* 5*d.*, *Bywater*, 160; for 1844-5-6, see p. 656.—Neilson and Co.'s shore dues in these three years, retained by them, amounted to 131*l.* 10*s.* 1*d.*, *ib*; *Bywater*, 160.
Expenditure.—In 1841, 69*l.* 11*s.* 6*d.*; 1842, 117*l.* 13*s.* 9*d.*; 1843, 24*l.* 16*s.* 6*d.*, *Bywater*, 160.

MILLPORT:
The pier at this place built by private subscription, at a cost of nearly 1000*l.*, *Lennox*, 518.—It affords accommodation at high water for vessels drawing 16 feet of water, and at low water 6 or 7 feet, *ib.*—The extension of the pier so as to accommodate vessels drawing 20 feet water could be made at the cost of a few hundred pounds only, *ib.*—A grant for this purpose would probably be the means of preventing many wrecks, *ib.*—Account of tonnage dues, &c., *ib.*—Rep. liv.
Income and Expenditure:—
Income.—In 1841, 227*l.* 12*s.* 6*d.*; 1842, 70*l.* 11*s.* 5*d.*; 1843, 63*l.* 12*s.* 8*d.*, *Lennox*, 518; for 1844-5-6, see p. 656.
Expenditure.—In 1841, 287*l.* 14*s.* 5*d.*; 1842, 79*l.* 2*s.* 2*d.*; 1843, 59*l.* 13*s.* 5*d.*, *Lennox*, 518.

MONTROSE HARBOUR—(RIVER SOUTH ESK):
Present condition of Harbour:—
This harbour is formed by the outlet of the South Esk, which falls into the sea between Scurdy Ness on the south and the Annat Sand on the north, Rep. xxx.—The latter forms a natural breakwater, having a channel 170 yards, with a depth of 18 feet at high-water springs, and 15 feet at neaps up to the town quays, *ib.*—The channel which connects the slake with the sea forms the harbour, *ib.*—The river is not subject to freshes of any importance, but at all times, except at slack water, there is a rapid current, *Burnes*, 253.—A vessel of 500 tons can come up to the bridge, and there is accom-

MONTROSE HARBOUR (RIVER SOUTH ESK)—continued.

Present Condition of Harbour—continued:—

modation in the harbour for four times the present traffic, *Roberts*, 254.—There is a depth of 18 feet at the river entrance at low water, and 8 feet at the Cross Dykes, *Birnie*, *ib.*

Quays.—They would not, in their present state, admit of dredging, so as to keep certain vessels afloat, and a wet dock was therefore rendered necessary, *Burnes*, 253.—They might have been rebuilt for about 25,000*l.*, *ib.*—The quays are far from being in a good state of repair, *Birnie*, 254.

Dock.—A wet dock of 3½ acres was designed and carried out by Mr. Leslie of Dundee, *Burnes*, 253.—The entrance is 55 feet wide, with 19½ feet water over the sill of the gates at spring-tides, and 16 feet at neaps, *ib.* There is a patent slip proved for 400 tons, *Burnes*, 253; *Burn*, 254.—And about 100 men employed in ship-building, *ib.*—A ship of 440 tons, drawing 17 feet, has been in dock, *Birnie*, 254.—The dock is a very great benefit to the shipping interest, *Burn*, *ib.*; *Smart*, *ib.*—The entrance-gates would admit the largest war-steamers in width, and, except at Dundee, there is no similar dock in Scotland, *Burn*, *ib.*—The dock quays afford 1,500 feet of wharfage, and the main quays 1,700 feet, *ib.*—There is no graving dock, *ib.*

Lights.—The two lighthouses exhibiting leading lights were built at the expense of the merchants, in 1817, *Burnes*, 253.—The harbour may be run for at all times, as the leading lights kept in one lead into safety, *Birnie*, 254.—The two leading lights are good, Rep. xxx.

Tides.—The rise of tides on springs is 14 feet; on extreme tides, 16 feet; and 11 feet at neaps, *Burn*, 254.—The tide stream runs five knots in and out of the harbour, *ib.*—Owing to the projection of the dock wall, there is a better scour than formerly, *ib.*

Pilots.—There are 20 pilots who pass an examination before the harbour trustees and harbour-master, and receive each a badge and licence, *Burn*, 254.—They have only open boats, *ib.*—The rates of pilotage and bye-laws are publicly exhibited on the quays, *ib.*—They are paid by job and not by salary, *ib.*—There is a life-boat in good order, maintained by private contribution, *Burnes*, 253.

Obstructions.—The "Leads" and "Stone" are dangerous rocks, lying off Scurdy Ness, at the entrance of the harbour, without a beacon to mark them, Rep. xxx.—The suspension bridge at the entrance of the basin stops the navigation for everything except boats, *ib.*

The Slake.—An estuary of about 1200 acres westward of the town, covered with water at every tide, Rep. xxxi.—The preservation of the Slake necessary to the continuance of the harbour, *ib.*—Description of several embankments recently made by landed proprietors, and the probable injurious effect thereof upon the navigation, *ib.*—Montrose Harbour trustees not able, from want of funds, effectually to repress these encroachments, *ib.*

Management:—

The harbour is governed under Act 1 Vic., c. 99, which appoints twenty-two persons (including eight merchants or shipowners of Montrose) as trustees, *Burnes*, 253.—The Act gives power to raise 40,000*l.*, which has been borrowed, and, with an additional 5000*l.*, expended on a wet dock and other improvements, *ib.*—Prior to this Act, the harbour was governed by the Town Council, under charter of David II., by virtue of which shore dues had been levied, quays built, and other works done, *ib.*

Income, Expenditure, and Debt:—

Income.—The revenue of the port has considerably increased since the formation of the wet dock, *Burnes*, 253.—Abstract of the amount collected from harbour and light dues, from 1840 to 1846, *Smith*, 254.—The books and accounts of the trustees produced, examined, and approved of by the Commissioners, *ib.*—The accounts are annually audited and published, *ib.*—It would be a great boon if Government would lend 40,000*l.* to the harbour at a low rate of interest, as this would enable the trustees to carry out the improvements suggested, *Birnie*, 254.—In 1841 the income amounted to 3,441*l.* 8*s.* 5*d.*; 1842, 3406*l.* 13*s.* 3*d.*; 1843, 3187*l.* 10*s.* 7*d.*, *Burnes*, 260; for 1844-5-6, see p. 658.—The dues are levied by Charter and the Act 1 Vic. c. 99, *Burnes*, 260.

MONTROSE HARBOUR (RIVER SOUTH ESK)—continued:

Income, Expenditure, and Debt—continued:—

Expenditure.—In 1841, 2654*l.* 3*s.* 11*d.*; 1842, 2869*l.* 13*s.* 9*d.*; 1843, 3239*l.* 11*s.*, *Burnes*, 260.—The cost of obtaining the Act was 2500*l.*, *ib.*

Debt.—45,650*l.*, due on 1st of January, 1846, *Burnes*, 260.—40,000*l.* have been borrowed under the Act, and 5000*l.* additional expended on improvements, *Burnes*, 253.—The rate of interest on the debt is 4½ per cent., *ib.*

Shipwrecks and Lesser Damage:—

Damage occasionally arises from freshes when heavy, and from the swell and range in the harbour at high water in easterly gales, *Roberts*, 254.—Has known a vessel break her back while lying aground alongside the quays, but there is not half the damage now that formerly occurred, *Birnie*, *ib.*—The chief wrecks take place on the Annat Bank, but it would be difficult to find any remedy for that sand, *ib.*—The "Victor" received some damage in consequence of the dock not opening into a tidal basin, *Burn*, *ib.*

Shipping and Tonnage:—

In 1845 the arrivals were 934 vessels, of 62,677 tons, of which the coasting were 52,952, and the foreign 9725.—The vessels belonging to the port were 108, of 14,000 tons, *Smith*, 254.—Abstract of the number of arrivals and tonnage from 1840 to 1846, *ib.*, Rep. xxx.

Improvements Effected and in Progress:—

45,000*l.* have been expended on a wet dock and other improvements, *Burnes*, 253.—The wet dock was rendered necessary in consequence of damage received by sharp vessels lying alongside the quays, *ib.*—The slake has rather deepened since the removal of the old bridge, *Roberts*, 254.—Since its removal, the water in the upper part of the harbour has materially deepened, *Birnie*, *ib.*—There are 16 feet water at this bridge, *ib.*

Improvements Suggested:—

The Leads, a cluster of rocks about 200 yards off the Ness, are a great evil to the harbour, and cause much risk to vessels taking it, *Roberts*, 254.—Opinion, that the Leads are a protection to the harbour, *Birnie*, *ib.*—The "Leads" and "Stones" are dangerous rocks at the entrance of the harbour, and should be dredged or blasted away, Rep. xxx.—The Cross Dykes, a ridge across the river, should be dredged or blasted away, *Birnie*, 254; *Smart*, *ib.*—The channel, from this spot to the Stell, requires to be dredged, *Birnie*, *ib.*—All agree that the Stone, a rock running out directly from the Ness, should be removed, as it narrows the entrance to the harbour, *ib.*—The shingle bank, called the Scalp, should if possible be removed, *Birnie*, 254; *Burn*, *ib.*—Or its encroaching on the north side of the river prevented, *Birnie*, 284.—With this view the arch in the bridge on the south side should be shut up, *ib.*—The quays should be clamped, *ib.*—It would be easier to get vessels into the dock if it opened into a tidal basin, *Burn*, *ib.*—The improvement most wanted is a dredging machine, *Smart*, *ib.*—A tug-steamer is also much needed, *ib.*

Complaints:—

Statement, as to the encroachment of Sir J. Carnegie, in 1842, by running an embankment from the old pier, so as to enclose 65 acres of the bed of the basin, and to exclude 12,000,000 cubic feet of water every spring tide, *Burnes*, 253.—The harbour trustees protested, and have been prevented by want of funds only, from instituting legal proceedings, but have applied to the Admiralty, and the case has been referred to the Lord Advocate for his decision, *ib.*—Three other encroachments have been made by Sir J. Carnegie, or his predecessors, in 1817, 1830, and 1831, two of them of 30 acres each, *ib.*

Miscellaneous Papers and Reports of Engineers:—

Return to Order of House of Commons of 9 Aug. 1844, 255.—Walker, on the proposed wet docks at Montrose, 1839, *ib.*—Answers to Mr. Rendel's queries as to the basin and harbour, and Sir J. Carnegie's embankments, 1842, 256.—Rendel on enclosing tidal mud lands near Old Montrose, 1842, 257.—Correspondence as to embankments in South Esk and Montrose estuary, 1842-1845.—Return of income and expenditure for 1841-2-3, 260. The harbour is formed by an east pier, with an elbow parallel to the shore enclosing four acres,

MORRISON'S HAVEN:
Rep. xviii.—The entrance is 70 feet wide and 14 feet deep at high-water springs, *ib.*—The shore dues for the last three years less than 40*l.*, and have not covered the cost of collection. There has been no expenditure on the harbour during the last three years, *Suttie*, 85.—Considerable sums have at different times been expended by the proprietors of the barony, *ib.*—In the last 10 years, witness has expended in improving the harbour ten times the sum received as shore dues, *ib.*—The arrivals in 1846 were 53 vessels of 3718 tons, of which 7 were foreign, Rep. xviii.—The dues collected by ancient custom founded on a grant from the Crown, *Suttie*, 85.—Revenue in 1844, 34*l.* 14*s.* 5*d.*; 1845, 39*l.* 10*s.* 9*d.*; 1846, 62*l.* 13*s.*, Supp. 658-9.—Return to Address of the House of Commons of 29 July, 1844, *ib.*

MULL OF KINTYRE:
Description of the light at this place, Rep. xlv.

NAIRN:
The mouth of the river constitutes the harbour; the entrance both narrow and shallow, but with a rise of 14 feet at springs, Rep. xxxvi.—The old channel was altered by Telford in 1820 at a cost (including compensation to the salmon fishers) of 5,500*l.*, *ib.*—The alteration not generally considered an improvement, as vessels of 200 tons are stated to have used the old channel, *ib.*

Income and Expenditure:—

Income.—In 1841, 83*l.*; 1842, 90*l.*: 1843, 101*l.*, *Davidson*, 340; for 1844-5-6, see p. 656.

Expenditure.—In 1841, 35*l.* 9*s.* 2*d.*; 1842, 23*l.* 13*s.*; 1843, 120*l.* 4*s.* 1*d.*, *Davidson*, 340.

Miscellaneous Papers and Reports of Engineers:—
Gibb, on improving the harbour, and estimate, 1816, 340.—Telford, on improving the harbour, 1816, 342.—Petition of the magistrates to the Convention of Royal Burghs, on the want of means for repairing the harbour, 1834, *ib.*—Mitchell, on the best means for remedying damage done by land-floods, 1835, 344.—Gibb and Mitchell, on means for counteracting the injurious effects of land-floods, 1837, 345.—Leslie and Mitchell, on constructing a breakwater, 1845, *ib.*

NEWBIGGIN:
A small but well-sheltered harbour on the eastern side of Starlie Point, the property of the Carron Company, Rep. xxiv.—It is formed by a south pier projecting eastwards, and has a depth of 15 feet at spring tides, *ib.*

NEWBURGH—RIVER YTHAN.
Description of the harbour, Rep. xxxiii.

NEWBURGH—PERTH:
Was used as a stopping place before the river above was deepened, Rep. xxvii.—There is a long river quay and several jetties, *ib.*—The arrivals in 1846 were 114 vessels in cargo of 7737 tons, *ib.*

Income and Expenditure:—

Income.—In 1841, 81*l.*; 1842, 77*l.*; 1843, 79*l.*, *Cameron*, 172.—Levied by consent, Rep. xxvii.

Expenditure.—In 1841, 41*l.*; 1842, 37*l.*; 1843, 38*l.*, *Cameron*, 172.

NEWHAVEN:
Has a substantial stone pier and slip extending to low water, erected at the joint expense of the Crown and the trustees of Fife Ferry, Rep. xxi.—The pier encloses a small harbour for wherries and fishing-boats, *ib.*—More accommodation required for the 180 boats, and numerous fishermen employed, *ib.*—The pier is now undergoing considerable repairs, *ib.*—A chain pier 170 yards long, and reaching to a depth of 5 feet at low water, was built at Trinity, in 1821, 500 yards west of the stone pier, at a cost of 4000*l.*, *ib.*

NEWPORT:
Revenue in 1844, 7*l.* 2*s.* 4*d.*; 1845, 5*l.* 12*s.* 4*d.*; and in 1846, 5*l.* 2*s.* 4*d.*, Supp. 656-7.—Return to Address of the House of Commons of July, 1844, 171.

NORTH BERWICK:
This harbour has an area of about three-quarters of an acre, enclosed by piers, Rep. xviii.—The entrance is 25½ feet wide, and 13 feet deep at the piers, *ib.*—It is not very easy of access, but secured from bad weather by boom-gates when once entered, *ib.*—Description of locality, which is considered by some well adapted for a national harbour, *ib.*—The want of a low-water pier much felt, *Dale*, 86; a low-water pier could be erected at little expense, and would tend greatly to the efficiency of the port, *ib.*—The expense alone prevents this being done, *ib.*—The harbour was thoroughly repaired, enlarged, and improved about thirty years since, *ib.*—The arrivals in 1846 were 65 vessels, of 1941 tons, Rep. xix.—The harbour is under the management of the magistrates and Town Council, acting under charter granted by James VI. in 1568, *Dale*, 86.—The reports of the engineers employed in improving the harbour cannot be found, *ib.*—Description of favourable situation in the vicinity for formation of harbour of refuge, *ib.*—Statement of income and expenditure of the port in each year ending October 1842-3, and 1844; average income 28*l.* 16*s.* 9*d.*; average expenditure, 18*l.* 6*s.* 10*d.*, *ib.*, Rep. xix.—Income in 1844, 56*l.* 1*s.* 6*d.*; 1845, 107*l.* 7*s.* 11*d.*, Supp. 658.

NORTHERN LIGHTS:—
Commissioners of—Extract of secretary's letter on want of lights and buoys on the coast of Scotland, Supp. 652.—Account of number and tonnage of vessels which have paid dues to the Board of Northern Lights in the year 1846, Supp. 652.

OBAN:
The bay is spacious and well sheltered, and affords 100 acres of good anchorage in from 10 to 20 fathoms of water, Rep. xliv.—There are two quays at the town at which vessels may discharge and take in cargoes, *ib.*—The arrivals and sailings in 1846 were 387 loaded vessels, of 21,657 tons, one-third of which were steamers, *ib.*—Revenue in 1844, 22*l.* 3*s.* 4*d.*; 1845, 22*l.* 1*s.* 11*d.*; 1846, 18*l.* 7*s.* 5*d.*, Supp. 656-7.—Return to Address of the House of Commons of July, 1844, showing the income and expenditure of the port, 377.

PENTLAND FRITH:
Description of, Rep. xli.

PACKET STATIONS:—
Exposed state of Port Patrick, Rep. lviii. xlii. xlvii., 564, 569, 578.

PERTH HARBOUR (RIVER TAY):
Present Condition of Harbour:—
A harbour has been begun and proceeded with to some extent, but left unfinished from want of funds, *Wedderspoon*, 173; *Stevenson*, 174.—Statements as to deficiency of berthage, *Wedderspoon*, 173; *Graham*, *ib.*; *Stevenson*, 174; *Garie*, 175.—The four schemes proposed for crossing the river are all prejudicial to navigation, *Stevenson*, 174; *Anderson*, 175; *Garie*, *ib.*—There is one tidal basin of 2½ acres area, 12 building-slips, six being occupied and employing 100 shipwrights, and two foundries for casting and repairing machinery, *ib.*

Quays.—The quays were originally erected by the city, but under the new Acts they have been repaired and extended, *Wedderspoon*, 173.—Some of the quays are built of concrete, and have stood well, *Stevenson*, 174.—The foundation of the stone quays built by Mr. Jardine, is barely deep enough to admit of further dredging, *ib.*—The timber quays are much out of order, *ib.*—There are about 2000 feet of quays in all, *Garie*, 175.—The timber quays are not bored by any insect, *ib.*

Dredging.—The river has been deepened by dredging, as far down as Newburgh, *Wedderspoon*, 173.—The sandbank is allowed to remain from want of funds, *Ballingal*, 174; *Blair*, *ib.*—A depth of 15 ft. throughout has been obtained; the flood-tide brought up 50 minutes earlier to Perth bridge, the duration of the tide prolonged, and a million cubic yards of additional water pass Newburgh every tide, *Stevenson*, 174.—There is a tendency in the river to fill up at the bottom of Willow-gate, and some of the fords have risen since the river was deepened—the only remedy is the occasional application of the dredge, *ib.*—There is one dredging machine of 12-horse power, *Garie*, 175.—When at work, 690 tons of soil are dredged per day, at a cost of 1¼*d.* per ton, exclusive of machine and wear and tear, *ib.*

Cranes.—There are two; one capable of lifting six, and the other three tons, *Garie*, 175.

Tides.—The tide flows 2½ miles above Perth bridge, *Stevenson*, 174.—The Tay has been known to rise from 10 to 12 ft. in 24 hours, *Anderson*, 175.

PERTH HARBOUR (RIVER TAY)—continued:

Present Condition of Harbour—continued:—

The Tay, and its tributary the Earn, discharge 273,117 cubic feet per minute, *ib.*—The rise of tide at Perth ranges from 14 ft. on extreme springs to 6 ft. on neaps, and the time of high water at full and change is 3 hours and 55 min., *Garie*, 175.—The stream runs ordinarily from 2 to 2½ miles, and from 4 to 5 knots in freshes, *ib.*—Results of Messrs. Stevenson's observations on the tides, from 1833 to 1844, 189.

Pilots.—There are two pilots belonging to the port, licensed by the Trinity-house of Leith, *Garie*, 175.

Buoys and Beacons.—Those in the upper part of the Tay are not considered sufficient, *Garie*, 175.

Management:—

The harbour is governed by three Acts, viz., 2 Geo. IV., 1 Will. IV. c. 121, 4 & 5 Will. IV. c. 67, and 2 Vict. c. 21, *Wedderspoon*, 173.—These Acts appointed 30 Commissioners, to include the member for the City, 14 of the Town Council, 6 commissioners of supply, three shipowners, and 6 burgesses of Perth, but no sailor is required by the Act, *ib.*—These Acts gave power to levy dues, and to borrow money to the extent of 50,000*l.* on the security of the rates, *ib.*—Prior to the passing of these Acts, the affairs of the harbour and the river navigation were in the hands of the Perth magistrates, in virtue of rights, powers, and privileges conferred on them in early times by kings of Scotland, confirmed by charter and decree arbitral of James VI., and ratified by Act of the Scotch Parliament, dated 9 July, 1606, *ib.*—These did not give power to levy increased dues, nor to take land to improve the river, and the above-named Acts had therefore been applied for, which, however, reserve the prior rights, &c., of the Perth magistrates, *ib.*—Treasurer's books produced, examined, and approved of, 174.—Under the former management, the interests of navigation in the Tay were altogether neglected, Rep. xxvii.—Jetties or dykes, to form new ground, were run out at pleasure, and large heaps of stones, called fishing cairns, erected at will in the bed of the stream, *ib.*—The interests of the landed proprietors and of the owners of the fisheries invariably preferred at the expense of the navigation, *ib.*

Income, Expenditure, and Debt:—

Income.—In 1842, 3328*l.* 4*s.* 3½*d.*; 1843, 3352*l.* 2*s.* 0½*d.*; 1844, 3357*l.* 19*s.* 10½*d.*, *Chapman*, 193; for 1845-6, see p. 658.—The dues are levied under the Act 4 and 5 Will. IV. cap. 67, *Chapman*, 193.—The amount of shore dues, in 1845, was 4224*l.*, *Wedderspoon*, 173.—The amount of revenue, on an average of four years, was 3581*l.* 1*s.* 10*d.*, *Chapman*, 174.—One-twelfth is paid to the town of Perth in lieu of their right to levy dues under their charters, *Wedderspoon*, 173.—Proprietors of certain shipping places in the Tay claim exemption from dues on the exports of the produce of their lands, and on the imports of manure, coal, &c., for use on their estates, *ib.*

Expenditure.—All the proprietors of salmon fisheries on the river have claimed compensation for supposed injury; 5,000*l.* has been paid as temporary damage, and a sum as permanent compensation is shortly to be decided on and paid, *ib.*—A sum of 61,917*l.* 18*s.* 4*d.* has been laid out in improvements, besides interest on debt, which amounts to 19,233*l.* 9*s.* 9*d.*—The Commissioners have been obliged to devote a portion of the funds (3000*l.*) to preserve this fine river from being crossed at different points by railway bridges, *ib.* 173, 174.—In 1842 the expenditure amounted to 4029*l.* 5*s.* 2*d.*; 1843, 3889*l.* 18*s.* 4½*d.*; 1844, 3404*l.* 11*s.* 2½*d.*, *Chapman*, 193.

Debt.—The whole debt is 43,070*l.*, *Chapman*, 193.—It would be a great boon were Government to lend money at a low interest to pay off the harbour debts, *Chapman*, 174.

Shipping and Tonnage:—

At one time 40 vessels had been seen in the port, *Wedderspoon*, 173; *Garie*, 175.—940 vessels arrived at and departed from Perth during last year, *Stevenson*, 174; *Garie*, 175.—Of these, 1,000 tons were foreign, and 4500 tons coasting, *Garie*, 175.—The arrivals in 1846 were 1413 vessels of 72,433 tons; of these, 48 vessels of 4016 tons were foreign, Rep. xxviii.—The proposed schemes for crossing the river by railway bridges would all be inconvenient, and at times dangerous to the shipping, *Stevenson*, 174.—They would impede navigation, *ib.* *Anderson*, 175.—*Garie*, *ib.*—Vessels drawing 14 ft. can come up to Perth, *Garie*, 175.—The tonnage of sailing vessels belonging to the Port and Creek of Newburgh, is 10,000 tons, *ib.*—There are two steam-tugs, one of 28, the other of 30-horse power, besides the river steamers trading daily to Dundee, *ib.*

Plans and Surveys:—

A detailed plan of the river has been made by Messrs. Stevenson, and on this the improvements of the river were based, *Wedderspoon*, 173.—They made a detailed chart from Perth to Invergowrie and Balmerino, with soundings to Newburgh, eight miles from Perth, *Stevenson*, 174.

Improvements Effected and in Progress:—

A harbour has been begun and proceeded with to some extent, but is unfinished from want of funds, *Wedderspoon*, 173; *Stevenson*, 174.—The river has been deepened by dredging as far down as Newburgh, *Wedderspoon*, 173.—The large sum of 61,917*l.* 18*s.* 4*d.* has been expended in improvements, *ib.*—Great good has been done in deepening the river, but not all that might have been effected, *Graham*, *ib.*—The shoals in the channel of the river at Dairy and Mugdrum have been removed by dredging, boulder stones of large size and fords removed, directing walls built, back channels shut up, and the current in flood and ebb induced to run in the same channel.—Thus a depth of 15 feet has been obtained, the tide is brought up 50 minutes earlier to Perth Bridge, its duration prolonged, and a million cubic yards of additional water pass Newburgh every tide, *Stevenson*, 174.

Improvements Suggested:—

Additional room is still wanted, and increased accommodation very desirable, *Wedderspoon*, 173; *Garie*, 175.—There is great want of room on the shore, occasioned partly by a large sandbank, immediately opposite, being permitted to remain and accumulate, *Graham*, 173.—The middle bank, and the shelf of Friarton, should be removed, Rep. xiii.—Further deepening of Elcho, and more buoys and beacons are wanted, *ib.*—There should be at least six shipowners or sailors on the Board, *Graham*, 173; *Dow*, 174.—The salmon fisheries are a great obstacle to improvement, *Wedderspoon*, 173; *Graham*, *ib.*—This should not be permitted, *Graham*, *ib.*—The shipping interest calls loudly for the completion of the tidal basin or harbour, *Stevenson*, 174; *Garie*, 175.—From the great quantity of ice in the river during winter, such a harbour is urgently called for, *Stevenson*, 174.—It should be proceeded with, even by the 100 yards at a time, the cost per 100 yards being 1800*l.*, *ib.*—Nothing but the want of funds prevents the river being deepened so as to give 19 or 20 feet water up to Perth, *ib.*—The cost would be 50,000*l.*, *ib.*—By equalizing the slope of the river bed from Perth downwards, the tide would be brought up earlier, *ib.*—The timber quays want repairs, *ib.*—The middle bank and shelf off Friarton Island should be removed, *Garie*, 175.—The railway crossing should be above the water-pipe, *Anderson*, 175.

Complaints:—

That Government leaves the task to the Perth Commissioners of defending the Tay, and allows the expense of its defence to fall on their limited funds, *Wedderspoon*, 173.—Of the great expense incurred by the town and river conservators in opposing railway projects that would interfere with the navigation, *ib.*, 174; *Barlas*, *ib.*, Rep. xiii.—That only three shipowners are entitled to sit at the Board, *Graham*, 173; *Dow*, 174.—Of great want of room, *Graham*, 173; *Stevenson*, 174; *Garie*, 175, Rep. xxviii.—That this want of room is partly occasioned by a large sandbank opposite the shore being allowed to remain and accumulate, *Graham*, 173, 174.—That the salmon fisheries are a great obstacle to improvement, *ib.*, Rep. xxviii.

Reports of Engineers, &c.:—

Anderson, on the discharge of the Tay, 1831, 176.—Stevenson and Son, on improving the Tay navigation between Perth and Newburgh, making a tide harbour and wet dock at Perth, and estimate, 1834, 176.

PERTH HARBOUR—continued:

Reports of Engineers—continued:—

—Stevenson and Son, on the Tay, and proposed railway bridge over it, 1845, 182.—Rendel, on the proposed bridge, 1845, 190.

Miscellaneous Papers:—

Return to Order of House of Commons of August, 1844, 175.—Memorial of Perth Magistrates and Navigation Commissioners to the Admiralty, 1844, 179.—Memorial of Harbour and Tay Navigation Commissioners to the Tidal Harbour Commissioners, 1845, 192.—Statement of sums received and expended under Perth Navigation and Harbour Acts, from 1830 to 1846, 193.—Return of Income and Expenditure for the years 1842-3, and 1844, 193.

PETERHEAD:

Present Condition of Harbour:—

Description of the harbours, *Rennie*, 304, Rep. xxxiii.—The extent of the south harbour is about 6½ acres, *Gray*, 300.—About 7, *Stevenson*, 302.—The area of the north harbour is 10¾ acres, *Gray*, 300.—About 10, *Stevenson*, 302.—The south harbour is dry at low water, *Gray*, 300; *Souter*, 301; *Stevenson*, 302.—Cranes have been erected on the quays, *Gray*, 300.—No ballast is allowed to be thrown into the harbour, *Souter*, 301.—Boards with harbour and pilot regulations are exhibited in two places on the quays, *ib.*—The north harbour, from the graving dock, northwards, is afloat, and has 8 feet depth at the pier heads at low water, *ib.*—Spring-tides rise 11½ to 12 feet; neaps 6 feet, *ib.*—Vessels have been detained days, and sometimes weeks, from want of a cut between the harbours, *ib.*—The north harbour is uneasy to lie in, *ib.*—If the cut were made all would seek shelter in the south harbour, *ib.*—At high-water springs, a vessel drawing 15½ feet can enter the north, and one 13½ feet draft can enter the south harbour, *Lawrie*, 301.—Vessels can put into Peterhead when they cannot get shelter in the Moray Frith, nor go southward, *ib.*—The sea is very heavy at times, *ib.*—Vessels in the north harbour strike on the ground, and tear away their fastenings, *ib.*—Peterhead is well known as the head quarters of the Greenland whale fishery, and has latterly become the principal herring fishery station on the coast, Rep. xxxiii.

Dredging.—Excavations of rock from the bottom of the south harbour are made occasionally, and deposits of mud from the streets are removed once in two years, *Gray*, 300.—No mud, sand, or gravel washed in from the sea, *ib.*—The rock in the bottom of the harbour is too hard to be dredged, and must be excavated, *ib*; *Souter*, 301.

Quays.—The length of the south quay of the south harbour is 480 feet, its breadth, 42 feet, *Souter*, 301.—Length of west quay, 653 feet, width of entrance, 90 feet, *ib.*—Total length of quays of the north harbour, 2,220 feet, width of entrance, 1,000 feet, *ib.*

Dock.—There is one graving dock on the east side of the north harbour, 130 feet long, 56 feet wide, and its entrance 34 feet wide, *Souter*, 301.—This dock is a great advantage, but a patent slip is much wanted, *Lawrie*, *ib.*

Light.—A standing red light is shown on the west pier head of the south harbour, visible 3½ miles off, *Souter*, 301.

Pilotage.—The pilots, 25 to 30 in number, are licensed by trustees in January, annually, on the Report of the pilot master, and after examination by the trustees, *Gray*, 300.

Management:—

Since 1807 the harbours have been managed under Acts of Parliament, *Gray*, 300.—The first commenced in 1807, and lasted for 21 years, and the second, being 7 and 8 Geo. IV., cap. 34, is perpetual, and that under which the harbours are now managed, *ib.*—Power is conferred to borrow 60,000*l.* on the security of the dues, *Gray*, 300.—The ex-officio trustees are the preses of the governors of the Edinburgh Merchant Maiden's Hospital, or the proprietor of the estate of Peterhead, the baron baillie or baillies of the town for the time, the resident factor for the hospital governors, the treasurer of the town, with sixteen trustees to be elected, *ib.*—By the Burgh Reform Act the magistrates and council are empowered to appoint two of their number as harbour trustees in room of the baron baillie and town treasurer, *ib.*—Including the ex-officio trustees, there are twenty, of whom fifteen are at present shipowners; five are a quorum, *ib.*—In terms of the Acts of Parliament no important works are commenced without communicating with the hospital governors, and obtaining their approval, *ib.*—The ordinary business and repairs are carried on by the local trustees, and a state of the revenue and expenditure is annually transmitted to the hospital governors for their information, *ib.*—Four of the trustees go out annually, and are not re-eligible for a year, *ib.*—The services of the trustees are gratuitous. They hold about twenty-five meetings per annum, *ib.*—The harbour belonged formerly to the Earl Marischal, afterwards to the York Building Company, and were purchased by the hospital governors with the Peterhead estate, *ib.*—The old haven, near to the Ronheads, formerly inhabited by fishermen, was built in terms of the contract of 1593, between the Earl Marischal and the feuars of the town, *ib.*—The south and west piers of the south harbour were planned by Mr. Smeaton, in 1773, and completed in 1781, for 3256*l.*, *ib.*—In 1807 Mr. Rennie recommended the excavation and enlargement of this harbour, and the extension of the return kant of the west pier, all which works were carried out at an expense of 13,800*l.*, *ib.*—In consequence of the insufficiency of this harbour, the late Mr. Thomas Telford was consulted, and the north harbour built at an expense of 25,194*l.*, and a north pier has since been completed, at a cost of 4800*l.*, *ib.*

Income, Expenditure, and Debt:—

Income.—In 1841 3547*l.* 4*s.* 11½*d.*; 1842, 3156*l.* 6*s.* 11*d.*; 1843, 3551*l.* 10*s.* 7*d.*, *Gray*, 324; for 1844-5-6, see p. 654.—In the year ended March, 1846, it amounted to 3756*l.* 13*s.* 11*d.*, *Gray*, 324.—The dues are levied under the Act 7 & 8 Geo. IV., *ib.*, 324.

Expenditure.—In 1841, 2551*l.* 17*s.* 3*d.*; 1842, 2990*l.* 0*s.* 8*d.*; 1843, 2628*l.* 14*s.* 3*d.*, *Gray*, 324—67,020*l.* expended on both harbours since 1797, *ib.*, 300.

Debt.—33,876*l.*, due 1st January, 1846, *Gray*, 324.—For which 4 per cent. interest is paid, *ib.*

Shipwrecks and Lesser Damage:—

Many vessels have breached the Maw Craig, a very awkward rock, just off the entrance to the harbour; and occasionally vessels are wrecked, *Lawrie*, 301—Lists of wrecks in the vicinity of Peterhead, 1816-1822, and 1828-1846, 322.

Shipping and Tonnage:—

Many wind-bound vessels take refuge here, *Gray*, 300.—Last year 232 ships, of 14,085 tons, did so, *ib.*—About 100 Archangel, American, and Baltic ships call for orders, *ib.*—Besides the whale fishery, the herring fishery has latterly much increased, 400 boats came in last year, *ib.*—Has known 145 vessels in the south harbour at a time, from strong southerly winds, *Souter*, 301.—There are 14 Greenland ships now belonging to the port, and about 150 foreign bound vessels call annually, *Jollie*, 301.—Statement of the number and tonnage of wind-bound vessels that have entered the harbour, for each of 12 years, to 1845, *ib.*—Statement of the number and tonnage in each year, from 1834 to 1846, 324, Rep. xxxiii.

Plans and Surveys:—

List of these contained in No. 204, p. 302.

Improvements Effected and in Progress:—

Excavations of rock from the bottom have been made occasionally, *Gray*, 300.

Improvements Suggested:—

The cut between the harbours, recommended by the engineer, has not been made, as to render it useful, the south and inner north harbour should be deepened, *Gray*, 300.—There is great want of further accommodation, *ib.*—The south harbour should be enlarged, *Vollum*, 301.—There is great want of a cut between the two harbours, *Souter*, *ib.*; *Lawrie*, *ib.*; *Anderson*, *ib.*; *Stevenson*, 302.—The rocks project to the west of the entrance to the south harbour, and would be better away, *ib.*—A very awkward rock, the Maw Craig, lies just off the entrance, and should be removed, *Lawrie*, 301.—The chief thing wanted is the deepening of the

PETERHEAD—continued:

Improvements Suggested—continued:—

north harbour, *ib.*; *Anderson*, 301.—Booms, or some other device, are wanted to still the water in the north harbour, as vessels strike and tear away from their fastenings, *Lawrie*, 301.—A patent slip is much wanted, *ib.*—A breakwater is much wanted to protect the north harbour, *Volkun*, *ib.*—Something is wanted to shelter its entrance, *Anderson*, *ib.*—The piers should be carried further out into deep water, *ib.* 301.—The area of the harbours should be excavated, *Stevenson*, 302.—Covering breakwaters should be projected from the shores, *ib.*

Harbour of Refuge.—A harbour of refuge is much wanted on this part of the coast, and Peterhead affords great facilities for its erection, *Gray*, 300; *Stevenson*, 301, 302.—This is the chief want, and it would be the greatest benefit that could be conferred on the east coast of Scotland, *ib.* 301; *Jollie*, 301; *Stevenson*, 301, 302.—To attain this object an additional depth of water, an extension of the harbours, with further protection to the north harbour, are necessary, *Souter*, 301.—Statement of the reasons why Peterhead is peculiarly adapted for the establishment of such a harbour, from its central position, the favourable formation of the coast there, its rocky composition, and the depth of water, *Stevenson*, 301, 302.—Execution of the minor works projected recommended to trustees as most conducive to the interests of the harbour, leaving the question of making a harbour of refuge to the Government, Rep. xxxiii.—Statement of its advantages for harbour of refuge, *ib.*

Reports of Engineers, &c.:—

Smeaton, on the harbour, 1772, 303.—Rennie, on enlarging and improving the harbour in accordance with his plan of 1806, with estimate, 1846, 304.—R. Stevenson, on the harbour, 1824, 311.—R. Stevenson, on the north harbour, 1826, 311.—R. Stevenson, on the best means of improving the harbour, with estimates, 1826, 312.—D. Stevenson, on improving the harbour, with estimates, and notes of evidence taken in 1846, 320, 321.

Miscellaneous Papers:—

Return by trustees, in 1845, of the titles of the Acts of Parliament under which they have acted; of the maps of the harbours in their possession, and of all reports of engineers or other officers, as to said harbours, made in compliance with Order of the House of Commons, of August, 1844, 302.—Report, by the harbour trustees, on Rennie's plan of improvement, 1812, 307.—Petition of the governors of the Maiden Hospital, to the Commissioners of Highland Roads, concerning improvements, 1815, 308.—Memorial of the harbour trustees to the same, concerning damage occasioned by storm, 1820, 309.—Memorial as to the proposed improvement and extension of the harbours, and their fitness for being formed into harbours of refuge, 1844, 314.—Lists of wrecks in the vicinity of Peterhead, 1816-22, and 1828-46, 322.—Statement of the number and tonnage of wind-bound vessels which have entered the harbours for refuge in each year, from 1834 to 1846, 324.—Return of the income and expenditure for the years 1841-2, and 1843, *ib.*

PETTYCUR:

Present Condition of Harbour:—

This harbour is formed by a south-eastern pier 123 yards long with a sluicing reservoir at its inner end, Rep. xxiv.—It has a depth of from 12 to 13 feet alongside the pier at springs over a bottom of mud, *ib.*—There is a tide light at the pier end, *ib.*—The harbour has recently been purchased by the Edinburgh and Northern Railway Company, *ib.*

Income and Expenditure:—

Income.—In 1842, 140*l.*; 1843, 162*l.* 10*s.*; 1844, 170*l.*, *Barclay*, 155; for 1845-6, see p. 656.—The dues are levied under two charters, one of James V. (1541), and the other of James VI. (1611), *Barclay*, 155.

Expenditure.—In 1842, 140*l.*; 1843, 140*l.*; and 1844, 170*l.*, *Barclay*, 155.

PITTENWEEM:

It has a small inner harbour or basin defended by booms, and an outer harbour formed by an old eastern and middle pier, Rep. xxv.—The entrance to the outer harbour is 75 feet wide, and to the basin 26 feet; the depth from 12 to 13 feet, *ib.*—The middle pier was repaired and rebuilt in 1822, *ib.*—The arrivals in 1846 were 38 loaded vessels of 1363 tons, *ib.*

Income and Expenditure:—

Income.—In 1842, 99*l.* 5*s.*; 1843, 80*l.* 5*s.*; 1844, 55*l.* 10*s.*, *Wilkie*, 163; for 1845-6, see p. 656.—The dues are levied under the Act of 1633, confirming the previous charters, *ib.*, Rep. xxv.

Expenditure.—In 1842, 131*l.* 13*s.* 2*d.*; 1843, 76*l.* 8*s.* 10*d.*; 1844, 29*l.* 3*s.* 7*d.*, *Wilkie*, 163.

PITTULIE:

The Fishery Board constructed a harbour at Sandhaven in 1838, a quarter of a mile estward of Pittulie, Rep. xxxiv.—The main piers extend 150 yards off shore in an east-north-east direction, with a return head of 43 yards to the south-east, *ib.*—The works cost 4205*l.*, three-fourths of which were contributed by the Board, *ib.*—The harbour is well sheltered and smooth in all winds, *ib.*

Income and Expenditure:—

Income.—In 1841, *nil.*; 1842, 5*l.* 0*s.* 10*d.*; 1843, 3*l.*, *Sutherland*, 330.—1846, 4*l.*, Rep. xxxiv; for 1844-5-6, see p. 654.—The dues are levied by the direction of the proprietor; there is no Act of Parliament, *Sunderland*, 330.

Expenditure.—In 1841, 9*l.* 9*s.* 10*d.*; 1842, 12*l.* 3*s.* 8*d.*; 1843, 1*l.*, *Sutherland*, 330.

PORT DUNDAS:

Return of income for the years 1841-2-3, 488; for 1844-5-6, see p. 656.—The expenditure not separately kept, 488.—The Provost, on the constitution of the harbour trust, December, 1846, 652.

PORT GLASGOW:

Present Condition of Harbour:—

This port is 18¾ miles below Glasgow Bridge, on the south side of the Clyde, and has good anchorage off it; is 18 feet at low water, and 28 feet at high-water spring tides, 491, Rep. liii.—There are two artificial harbours of 3½ acres each, and 130 feet wide at the entrance, and one wet dock of 10 acres, 53 feet wide, *ib.*—There is a depth of 14 feet on the sill of the lock at low water, *ib.*—Depth at entrance of harbour and lock on the outside, 10 feet, *ib.*—Spring tides rise 10 feet, neaps 8 feet, extreme tides 15 feet, *ib.*—Self-registering tide-gauge in use, *ib.*—Extent of wharfage, 4720 feet available, and 1570 feet not yet built, *ib.*—Water is laid down to the quays, *ib.* There are two quay cranes for 2½ tons each, *ib.*—A deposit of about 12 inches annually takes place, which is kept free by a steam-dredge of 20-horse power, raising 200 tons a-day, *ib.*—Cost of raising, 2½*d.*, and for depositing, 1½*d.* per ton, *ib.*—There is a harbour master, but no resident engineer, *ib.*—The pilots act under a joint Glasgow and Greenock Pilot Board, and are considered sufficient, *ib.*—Description and cost of the lights, *ib.*—There are three building-yards, employing about 150 shipwrights; one graving-dock, *ib.*—Evidence as to population of the port, distinguishing the seafaring population, *ib.*—Evidence as to minerals in the neighbourhood, *ib.*

Management:—

The harbours, by the Act of 1830, are governed by fifty members of the Corporation of Glasgow, with six members of the Port Glasgow Town Council, and five merchants, three of whom reside in Glasgow, 492.—Observations on the trust, Rep. liii.

Income, Expenditure, and Debt:—

Income.—In 1841, 2331*l.* 11*s.* 1*d.*; 1842, 1215*l.* 13*s.* 8*d.*; 1843, 1652*l.* 19*s.* 7*d.*, *Mathers*, 491; for 1844-5-6, see p. 658.—The dues are levied under the Act of 1840, *Mathers*, 491.

Expenditure.—In 1841, 2669*l.* 4*s.* 5*d.*; 1842, 2234*l.* 14*s.*; 1843, 2251*l.* 15*s.*, *Mathers*, 491.

Debt.—36582*l.*, due on the 1st of January, 1847, *Mathers*, 491.

Shipping and Tonnage:—

The tonnage belonging to the port, including steamers, 13,009; foreign arrivals, 91 ships, of 41,670 tons; departures, 79 ships, of 39,694 tons, 492.—Coasting arrivals and departures, 374 vessels, of 10,000 tons; regular traders, 74; casual, 300 vessels, *ib.*

PORT GLASGOW—continued:

Maps and Plans:—

The best charts and plans are the Admiralty surveys, recently made by Captain Robinson and Lieutenant Bedford, which ought to be published as early as possible, for the benefit of navigation, 492.

Improvements Suggested:—

To enlarge and improve the anchorage and navigable channel of the river by removing the perch opposite the harbour, 492, Rep. liii.—To build a graving-dock to accommodate ships which are now forced to go to Greenock for repair, *ib.*—To repair the gates and walls of the wet dock which have fallen in, *ib.*

Reports of Engineers, &c.:—

Walker, on the best means of obtaining additional accommodation, 1839, 489.—Atherton, on the construction of the proposed docks, 1833, 489.—Logan, on deepening the wet dock, and affording better accommodation, with estimate, 1837, 490.

Miscellaneous Papers:—

Return to Order of the House of Commons of August, 1844, 488.

PORT GORDON:

The property of the Duke of Richmond: it was built by the late Duke of Gordon, 40 years since, 336; Rep xxxv.—This place has a small district trade, *ib.*—The arrivals in 1846 were, 76 coasters of 4500 tons, besides 38 fishing-boats, manned by 136 men, *ib.*

Income and Expenditure:—

Income.—In 1842, 132*l.*; 1843, 135*l.*; 1844, 126*l.* 10*s.*, *Marquis*, 336.

Expenditure.—In 1842, 76*l.* 0*s.* 4*d.*; 1843, 232*l.* 18*s.* 6*d.*; 1844, 173*l.* 16*s.* 1*d.*, *Marquis*, 336.

PORT LOGAN (PORT NESSOCK BAY):

Description of, Rep. lviii.

Income and Expenditure:—

Income.—In 1841, 33*l.*; 1842, 47*l.* 2*s.* 8*d.*; 1843, 43*l.* 16*s.* 8*d.*, *Semple*, 591; for 1844-5-6, see p. 658.—The dues are levied under the Act 58 Geo. III., *Semple*, 591.

Expenditure.—In 1841, 11*l.*; 1842, 11*l.*; 1843, 11*l.*, *Semple*, 591.

Reports of Engineers, &c.:—

Rennie, on forming a small harbour at M'Ferrand's Isles, and estimate, 1813, ~~*ib.*—Young, on~~ forming a breakwater in Port Nessock Bay, 1820, 587.—Mathieson's estimate for the breakwater, 1820, *ib.*—Specification of ditto, 1820, *ib.*—Linn, on the means of improving Port Logan harbour, 1840, 591.

Miscellaneous Papers:—

Return to Order of House of Commons of August, 1844, 585.—Nine petitions to Parliament for converting Port Nessock Bay into a harbour of refuge, 1820, 588-591.

PORT MAHOLMACK:

Has a substantial pier extending 120 yards to the northward, with a return head of 23 yards, affording good shelter in easterly gales, Rep. xxxviii.—It was completed in 1816 at a cost of 3168*l.*, half of which was paid by Government, *ib.*—The arrivals in 1846 were 131 vessels of 7666 tons, *ib.*

Income and Expenditure:—

Income.—In 1842, 35*l.*; 1843, 35*l.*; 1844, 35*l.*, *Ross*, 358; for 1845-6, see p. 656.—The dues are levied under the authority of an Act of Parliament, *Ross*, 358.

Expenditure.—In 1842, *nil.*; 1843, *nil.*; 1844, 7*l.*, *Ross*, 358.

PORTPATRICK:

Present Condition of Harbour:—

This place has no claim to be called a harbour, Rep. lvii.—It affords a sheltered area of only half an acre, barely sufficient to accommodate two small mail steamers, *ib.*—The entrance is open to the heaviest and most prevalent gales, *ib.*—Observations on insecurity of this harbour, *ib.*—The old pier of Portpatrick which still stands good was completed in 1774, for 30,000*l.*, *M'Neil*, 559. Statement of its great natural advantages as a packet station, *ib.* 561; *Hawes*, 560; *Wallace*, 561; *Gillespie*, *ib.*—Some sewers empty into the harbour, *Finlay*, *ib.*—There is a certain filling up from these, from seaweed, and from soil brought down

PORTPATRICK—continued:

Present Condition of Harbour—continued:—

by heavy rains, but no great accumulation, *ib.*—Great inconvenience and some risk are felt from the foul state of the harbour, *Hawes*, 560.—There are only 3½ feet water on what is called the bar, *Finlay*, *ib.*—Of all the harbours in Great Britain, this affords the minimum amount of shelter for the large amount of public money laid out upon it, *ib.*

Dredging.—Representations as to the defects of the harbour, viz., the want of dredging and the removal of stones have been repeatedly transmitted to the Treasury, *M'Neil*, 559.—No dredgers have been employed in the harbour, but it has been deepened 15 inches with spoon and bag, *Finlay*, *ib.*—550*l.* would be the cost of excavating 11,000 cubic feet of soil, so as to get 7 feet low water in a channel 100 feet wide, *ib.* 560.

Tides.—The range of tide is 15 feet on springs, and 9 feet at neaps, or it rises on neaps to 12 feet above low-water springs, *Finlay*, 560.—A tide scale is placed at the north-east angle of the harbour, and a tide register has been kept for the last three years, *ib.*

Piers.—Prior to 1820, the only work was the old stone pier extending 200 feet in a north-east direction, *Finlay*, 559.—In 1820 the new works were begun by running out the south pier 430 feet, in a south-west ¼ west direction, with a jetty projecting at right angles to the north-west 75 feet, *ib.*—The inner quay walls have a batter of 10 feet in a height of 30, are built partly of freestone from the Clyde, Renton Quarry near Dumbarton, Anglesea limestone, and faced with Port St. Mary limestone, *ib.*—The width between the pier heads is 270 feet, and if the works were completed, it would be 170 feet, *ib.*—There is a crane on the pier to lift 7 tons, *ib.* 560.

Damage to the Works sustained during various Gales:—Breach made in the south pier head, and damage to the south-sea slope in 1839, *Finlay*, 559.—The landing slip of the old pier has been washed away, *ib.*—All the part of the slope most exposed at the south pier head was washed away to the southward and filled up the angle, *ib.*—The stones laid down in the angle of the south pier were lifted by the sea, and served as battering rams to breach the pier, *ib. Murdoch*, 560.

Lighthouse.—A lighthouse 50 feet high was built in 1834, and lighted till the heavy gale of January, 1839, since which it has remained unlighted owing to the difficulty of access to it in heavy weather, *Finlay*, 559-560; Rep. lvii.

Management:—

The Harbour Commission was constituted under 1 Geo. IV., c. 112, and consisted of 15 neighbouring landed proprietors. Since that 11 vacancies have occurred which have not been filled up, *M'Neil*, 559.—Three form a quorum, and all sign the minutes of meetings, *ib.*—Account of Charge and Discharge, with balance in Commissioners' hands, October, 1846, 561.

Income and Expenditure:—

Income.—The total sum received from the Exchequer, including 10,000*l.* voted in 1843, is 170,601*l.* 15*s.* 9½*d.*, *M'Neil*, 559.—The accounts are audited by the Commissioners and by the Treasury auditors, *ib.*—The secretary's salary is in arrear 7½ years, *ib.*—In 1831 a collection was made at all church doors for Portpatrick harbour, *ib.*—The passengers, &c., carried by the steamers yield an annual revenue of about 1000*l.*, and the mail bags average daily about six cwt., *ib.*—These returns are no criterion of the merits of Portpatrick as a packet station, were railway communication and proper mail packets established, *ib.*—800 men were employed on the harbour in 1825, and now there are only 25, *Murdock*, *ib.*—Witness's salary as clerk is in arrear four years, *ib.*—The income from shore and cattle dues, in 1841, was 7*l.* 10*s.*; 1842, 6*l.* 18*s.*; 1843, 7*l.* 1*s.*, *Semple*, 584; for revenue in 1844-5-6, see p. 658.

Expenditure.—For collecting dues less than 1*l.* per annum, *Semple*, 584.—The expenditure under the Act 1 Geo. IV., cap. 112, amounts to 167,666*l.* 6*s.* 1*d.*, 561.

Shipwrecks:—

List of wrecks in the vicinity of Portpatrick, from 1828 to 1845, 584.

PORTPATRICK—continued :

Plans and Surveys :—

Detailed plans of the harbours, with soundings taken by witness produced, *Finlay*, 559.

Improvements Suggested :—

Dredging, clearing, and deepening the harbour, *Finlay*, 560; *Hawes*, *ib.*; *Wallace*, 561; *Gillespie*, *ib.*—Removing the puddle dyke, and the accumulation of stones and other obstructions to the navigable channel, *ib.*—Building up the north pier, *ib.*—Forming a tidal basin of considerable extent, *ib.*—45,000*l.* would do the work, *Finlay*, 560.—The substitution of more powerful steam-packets, *Hawes*, *ib.*; *Wallace*, 561.

Reports of Engineers, &c. :—

Smeaton, on the capabilities of the harbour, and its improvement, 1770, *ib.*—Reports of Mr. John Rennie, and Sir John Rennie, on the formation of the harbour, 1817, 1818, and 1819, with estimates, 564-569.—Beechey, on the packet stations, and communication between the south of Scotland and north of Ireland, 1837, 569.—Sir J. Rennie, on the effects of the gale of 5 Jan. 1839, on the works at Portpatrick, 1839.—Sir J. Rennie, on the eligibility of the harbour as a packet station, 1842, 572.—Walker, on repairing the works of the harbour, and proposed improvement, 1843, 576.—Sir J. Rennie, on the fitness of Portpatrick for a packet station, 1843, 578.—Evans, on Portpatrick harbour, 1846, 580.—Sir J. Rennie's observations on Captain Evan's Report on Portpatrick, 9 April, 1846, 582.

Miscellaneous Papers :—

Statement of all sums received from the Exchequer by the Commissioners under the Act 1 Geo. IV. cap. 112, and of the sums paid for improving the harbour, with the balance in hand in Oct., 1846, 561.—Return to Order of the House of Commons of August, 1844, 502.—Extract from Treasury minutes of 28 May, 1839, 572.—List of wrecks in the vicinity of Portpatrick, from 1828 to 1845, 584.—Return of shore and cattle dues in 1841-2, and 1843, 584.

PORTREE :

The capital of the Isle of Sky has a well-sheltered harbour, with good holding ground, and a landing wharf or quay, erected in 1820 for 676*l.*, Rep. xliii.—The Kyle Rhea Ferry piers, to connect the island with the main, cost 1146*l.*; this, and the quay at Portree, built at the joint expense of the proprietor and the public, *ib.*—A light wanted on the Kyle of Akin, *ib.*

PORTSOY:

Present Condition of Harbour :—

This place has an outer and an inner harbour, with a depth of 10 feet at springs, Rep. xxxv.—It has a fair district trade in coal and grain, *ib.*—The arrivals in 1846 were 112 vessels, of 6046 tons, *ib.*

Income and Expenditure :—

Income.—In 1842, 236*l.*; 1843, 232*l.*; 1844, 286*l.* 13*s.* 4*d.*, 336; for 1845-6, see p. 654.—The dues are levied under the authority of the Earl of Seafield, the proprietor of the harbour, 336.

Expenditure.—In 1842, 23*l.* 18*s.* 2*d.*; 1843, 541*l.* 13*s.* 4*d.*; 1844, 356*l.* 18*s.* 11*d.*, 336.

PORT WILLIAM :

Description of the harbour, Rep. lviii.

Income and Expenditure :—

Income.—In 1842, 124*l.* 12*s.*; 1843, 123*l.* 2*s.* 9*d.*; 1844, 125*l.* 16*s.* 2½*d.*, *Cumming*, 594; for 1845-6, see p. 654.—The harbour was built by subscription of the proprietor and his tenants, by whom the dues were fixed, *Cumming*, 594.—The dues are cheerfully paid by the persons using the harbour, *ib.*

Expenditure.—Average of three years ending in 1844, 98*l.* 18*s.* 4*d.*, *Cumming*, 594.

Reports of Engineers, &c. :—

Buchanan, on the state of the harbour, and proposed improvements, 1812, 592.—Linn, on the mode of constructing the proposed pier, with estimates, 1841, 593.

Miscellaneous Papers :—

Return to Order of House of Commons of August, 1844, 592.

QUEENSFERRY :

South Queensferry has a small harbour, enclosed by piers, Rep. xxi.—The ferry, the great thoroughfare across the Firth, is at Newall, a short distance eastward, which has a substantial stone low-water pier, under the management of trustees, *ib.*

RENFREW :

Description of the harbour, Rep. li.—This port governed by the magistrates and Town Council of the burgh under various charters, the last being by Queen Anne in 1703, *Hutcheson*, 488.

Income and Expenditure :—

Income.—In 1842, 63*l.* 10*s.* 7*d.*; 1843, 47*l.* 5*s.* 7½*d.*; 1844, 60*l.*, *Hutcheson*, 488; for 1845-6, see p. 656.

Expenditure.—In 1842, 60*l.* 14*s.* 10½*d.*; 1843, 5*l.* 15*s.* 6*d.*; 1844, 7*l.* 1*s.*, *Hutcheson*, 488.

ROCKS :—

Description of—with suggestions for making of removal of, Burntisland, *Blue Rock*, Rep. xxiv.—Elie, *The Vows*, *ib.* xxv.—Montrose, *Leads* and *Stones* off Scurdy Ness, *ib.* xxx.—*Covesea Sherries*, and *Hallimans Scars*, Pentland Frith Rocks, *ib.* xli.

RONALDSHA :

Search, on the bad state of the harbours in the Orkneys, 1846, 627.

ROSEHEARTY :

Return to Address of the House of Commons of July, 1844, showing the revenue and expenditure of the port, and the authority under which the dues are levied and expended, 330.

ROTHESAY :

Description of the harbour, Rep. xlvii.

Income, Expenditure, and Debt :—

Income.—In 1841, 521*l.* 2*s.* 3*d.*; 1842, 503*l.* 17*s.* 11*d.*; 1843, 507*l.* 17*s.* 10*d.*, *Gillies*, 384; for 1844-5-6, see p. 656.—The dues are levied under 1 & 2 Will. IV. c. 34, *Gillies*, 384.

Expenditure.—In 1841, 1013*l.* 16*s.* 11*d.*; 1842, 432*l.* 13*s.* 11½*d.*; 1843, 309*l.* 14*s.* 8¾*d.*, *Gillies*, 384.

Debt.—1471*l.*, due on 1st January, 1846, *Gillies*, 384.

Reports of Engineers, &c. :—

Return to Order of the House of Commons of Aug., 1844, describing the harbour, what has been done for its improvement, the constitution of the harbour trust, and the decrease of the depth of water by the accumulation of sand, 381.—R. Stevenson, on improving the harbour, with estimate, 1815, *ib.*—Stevenson's Second Report on the same, 1820, 384.

SALTCOATS :

Description of the harbour, Rep. liv.

Income, Expenditure, and Debt :—

Income.—In 1841-2, 278*l.* 18*s.* 7¾*d.*; 1842-3, 146*l.* 9*s.* 10*d.*; 1843-4, 231*l.* 10*s.* 4*d.*, *Cunninghame*, 535; for 1844-5-6, see p. 656.—The dues are levied under Acts passed in 1797 and 1821, and 7 Vict. c. 45, in 1843, *ib.*

Expenditure.—In 1841-2, 269*l.* 11*s.* 8½*d.*; 1832-3, 87*l.* 10*s.* 8*d.*; 1843-4, 171*l.* 0*s.* 7½*d.*, *Cunninghame*, 535.

Debt.—5292*l.*, due on 1st January, 1846, 535.

Miscellaneous Papers :—

Return to Order of House of Commons of August, 1844, 533.—Specification of proposed improvements in the harbour, 1841, 535.

SARCLET :

Is defended from the sea by a massive breakwater pier, 35 yards long, extending from the south shore, and a jetty from the north, forming an entrance 12 yards wide, Rep. xl.—Description of breakwater, *ib.*—The whole of the works cost 3224*l.*, three-fourths of which were contributed by Government, *ib.*—The harbour is very confined, being less than half an acre in extent, and, from want of a beaching place, is very uneasy, *ib.*—Account of damage done to the boats in a storm, in 1839, from the unquiet state of the harbour, *ib.*—It is considered one of the best fishing stations on the coast, but less frequented than it would be if there were greater accommodation, *ib.*

SHIPPING AND TONNAGE :—

The shipping belonging to the different Scottish

Shipping and Tonnage—continued :—

ports consists of 3632 vessels, of 503,040 tons, Rep. xvii.—The arrivals and sailings in cargo, about 52,817 vessels, of 4,873,374 tons annually, *ib.*—Including the daily trips of steamers, the arrivals and sailings amount to about 150,000 annually, *ib.*—Account of number and tonnage of vessels which have paid dues to the Commissioners of Northern Lights in 1846, Supp. 653.—Statement of number and tonnage of arrivals at each port, distinguishing whether loaded or in ballast, coastwise, colonial or foreign, and also of vessels registered at each port, Supp. 655-659.—Abstract of the number and tonnage of vessels in cargo which entered and cleared from and to the British colonies, and foreign, in 1846, Supp. 660.—Number and tonnage of vessels taking shelter, in 1846, in certain ports in Scotland, Supp. 661.

SCRABSTER :

A pier now in course of erection at this place, which will have a depth at its head of 6 feet at low water and 19 feet at high water springs, Rep. xlii.—The anchorage of this roadstead of great value from its proximity to the Pentland Frith, and the shelter it affords in the prevailing westerly winds, *ib.*—The arrivals average about 500 annually.—A light on Little Head would be a great benefit and safeguard to shipping, and materially add to the usefulness of the anchorage, *ib.*—Stevenson, on extending the pier, Nov., 1847, 375.—Income, *Nil*, see p. 658.

SHETLAND ISLES :

Description of, Rep. xli.—Statement of trade and population, and extent of fisheries, *ib.*

SHIPWRECKS :—

Observations on the number of shipwrecks on the coast of Scotland, Rep. lx.

SINCLAIR BAY :

See Ackergill.

ST. ANDREW'S :

Present condition of Harbour :—

This harbour is in a good position to be of service to vessels embayed in an easterly gale between the headland of Fifeness and the Tay lands, Rep. xxvi.—The extension of the pier to low water, and the removal of the "Burn Stools," which might be done at small expense, would confer great local benefit, *ib.*—The arrivals in 1846 were, 155 vessels of 6025 tons, *ib.*

Income and Expenditure :—

Income.—In 1842, 163*l.* 14*s.* 11½*d.* ; 1843, 173*l.* 2*s.* 5*d.* ; 1844, 156*l.* 14*s.* 8*d.*, 170 ; for 1845-6, see p. 656.—The dues are levied by the authority of the magistrates of St. Andrew's, 170.

Expenditure.—In 1842, 26*l.* 1*s.* 1½*d.* ; 1843, 40*l.* 3*s.* 8*d.* ; 1844, 43*l.* 4*s.* 1*d.*, 170.

Miscellaneous Papers :—

Return to Order of House of Commons of August, 1844, 165.—Memorial of provost, magistrates, and town council, to the Commissioners of Highland roads and bridges, 166.—Notes and extracts from Minutes of Proceedings of town council relative to the harbour, *ib.*, Rep, xii.

SKIPNESS :

Description of pier and harbour, with extent of fishery, xlvi.

ST. DAVID'S :

Has an area of three acres, enclosed by east and west piers, with an entrance 205 feet wide and 16 feet deep at spring tides, Rep. xxiii.—198 vessels of 20,414 tons, loaded with coal, cleared out in 1846, *ib.*—No dues are levied, *ib.*—Correspondence in reply to Address of the House of Commons, 29 July, 1844, respecting this harbour, 153.

ST. MARGARET'S HOPE :

This roadstead offers a large expanse of good anchorage above Queensferry, and a harbour of refuge to vessels caught in an easterly gale off the entrance of the Frith, Rep. xxiii.—A few hundred pounds expended in lights and beacons for the upper part of the Frith would double its value, by making it available by night as well as by day, *ib.*

ST. MONANCE :

A small fishing harbour, formed by a single south-eastern pier, with a depth of from 10 to 12 feet at high water, Rep. xxv.—It has 85 boats, *ib.*

SOLWAY FRITH :

Robinson on the buoying and lighting of the Solway Frith, 16 March, 1847, 652.

STANLEY OR STARLIE-BURN,

A small harbour, used chiefly for shipping freestone from the adjoining quarries, Rep. xxiv.—It is enclosed by a south and west pier, the entrance 54 feet wide and 10 feet deep at springs, *ib.*

STIRLING—FORTH RIVER :

Present condition of Harbour :—

This port, from its position on the banks of a fine river, with a large rise of tides, and as the natural emporium of the Western Highlands, should be the outlet of an extensive district, and have a large trade, Rep. xxii.—The arrivals and sailings in 1845-6 were 45 loaded vessels of 1905 tons, *ib.*—Its natural advantages rendered useless by seven fords or shallows easily removable, which cross the river between Alloa and Stirling, and oppose a barrier to navigation, *ib.*—The weir at Craig Forth, five miles above the town, also an obstruction to the flow of the tide, *ib.*

Management :—

Prior to 1843 the harbour was under the control of the magistrates and Town Council of the burgh, in virtue of various charters, the last being granted by Charles I. in 1641, *Galbraith*, 145.—It is now governed by Commissioners under the Act 6 and 7 Vict. cap. 47, consisting of the provost, magistrates and Town Council of the burgh of Stirling, and two Commissioners from each of the counties of Stirling, Perth, and Clackmannan, under the name of the Forth Navigation Commissioners, *ib.*

Income, Expenditure, and Debt :—

Income.—In 1841-2, 140*l.* 15*s.* ; 1842-3, 146*l.* 5*s.* ; 1843-4, 1356*l.* 3*s.* 7*d.* (including 1000*l.* borrowed on the rates). In the last year, the dues were let at 356*l.* 3*s.* 7*d.*, *Galbraith*, 149 ; for 1844-5-6, see p. 654.

Expenditure.—In 1841-2, 22*l.* 16*s.* 6*d.* ; 1842-3, 614*l.* 2*s.* 9½*d.* ; 1843-4, 1069*l.* 18*s.* 10*d.*, *Galbraith*, 150.—In 1842-3, the expenditure includes 607*l.* 10*s.* 1½*d.* for Parliamentary expenses, and in 1843-4, 1026*l.* 1*s.* for the same service, *ib.*

Debt.—1600*l.*, due on 31st December, 1845, *Galbraith*, 150.

Reports of Engineers, &c. :—

Stevenson, on improving the river Forth, from Alloa to Stirling, with estimate, 1828, 145.

Miscellaneous Papers :—

Return to Order of House of Commons of August, 1844, 145.—Memorial of Forth Navigation Commissioners to the Treasury, 1845, 148.—Abstract of Mr. Galbraith's evidence before Tidal Harbour Commission in 1845, 149.—Abstracts of Mr. Stevenson's evidence before the same Commission in 1845, *ib.*—Return to Address of House of Commons of July, 1844, *ib.*

Complaints :—

That the money raised for improving the river has been ill expended in procuring the Act of Parliament giving power to execute other works, Rep. xxii.

STONEHAVEN :

Present condition of Harbour :—

This harbour, although small, has natural advantages which make it valuable to the coasting trade, Rep. xxxi.—It has an area of about 5 acres, enclosed by piers, with a depth of 15 feet at high-water spring at the pier head, *ib.*—Two inner jetties form the southern part into an inner harbour, with an entrance 50 feet wide, and a depth of 12 feet alongside the quays, *ib.*—There are leading lights on the north pier head, *ib.*—The arrivals in 1846 were 118 vessels of 5981 tons, Rep. xxxi.—Stonehaven is the chief station of a fishery district, 55 miles in length, extending from Broughty Ferry in the Tay to Girdleness, and comprising 22 creeks, and employing 298 boats and 1154 men, *ib.*—At Auchmithie and Johnshaven, two of the principal creeks, there are no piers or landing places, and the want of accommodation is much felt by the fishermen, *ib.*

Income, Expenditure, and Debt :—

Income.—In 1841, 471*l.* 6*s.* 4*d.* ; 1842, 412*l.* 17*s.* 3*d.* ; 1843, 386*l.* 10*s.* 5*d.*, *Tindal*, 268 ; for 1844-5-6, see p. 654.—The dues are levied under the Act 6 Geo. IV. cap. 54.

STONEHAVEN—continued:

Income, Expenditure, and Debt—continued:—

Expenditure.—In 1841, 115*l.* 14*s.* 6*d.*; 1842, 81*l.* 14*s.* 5*d.*; 1843, 75*l.* 0*s.* 3*d.*, *Tindal*, 268.

Debt.—Amount now due, 10,896*l.*, Rep. xxxi.

Reports of Engineers, &c.:—

Stevenson, on the best means of improving the harbour, with estimate, 1812, 261.—Stevenson's 2nd Report on the same, 1830, 267.

Miscellaneous Papers:—

Return to Order of House of Commons of August, 1844, 261.—Statement of the capabilities of the harbour, 1824, 266.—Memorial of harbour trustees to the Tidal Harbours Commissioners, 1846, 267.—Return of income and expenditure in 1841, 1842, and 1843, 268.

STORNOWAY:

Has an area of 130 acres of anchorage, sheltered from all winds, in a general depth of from four to five fathoms of water on a bottom of sand and mud, Rep. xliii.—There are 600 yards of quay wall and a building slip, *ib.*—The arrivals and sailings in 1846 were 218 vessels of 12,972 tons, and the customs' dues amount to 100*l.*, *ib.*—In addition to these 220 vessels of all nations anchored at Stornoway, either wind-bound or seeking shelter on their passage through the Minch, *ib.*—A low-water pier is in course of erection at the expense of the proprietor, and the inner harbour is to be deepened by dredging, *ib.*—A patent slip for vessels of 800 tons now being laid down, *ib.*—Return to Order of the House of Commons of August, 1844, 376.—Answers of Professor L. Gordon, C.E., to queries relative to the harbour, 1847, 377.—The income from tonnage dues, in 1842, amounted to 1*l.* 18*s.* 3*d.*; 1843, 4*l.* 2*s.* 5*d.*; 1844, 14*l.* 5*s.* 10*d.*; expenditure not stated, *Mackenzie*, 377; for income in 1844-5-6, see p. 658.

STRANRAER:

Description of the harbour, Rep. lvii.

Income and Expenditure:—

Income.—In 1841, 170*l.* 1*s.* 4*d.*; 1842, 147*l.* 15*s.* 4*d.*; 1843, 120*l.* 10*s.*, *Semple*, 558; for 1844-5-6, see p. 658.—The dues are collected by custom and authority of the Municipal Corporation, *ib.*

Expenditure.—In 1841, 25*l.* 5*s.* 1*d.*; 1842, 119*l.* 9*s.* 2*d.*; 1843, 17*l.* 6*s.* 6*d.*, *Semple*, 558.

Miscellaneous Papers:—

Return to Order of House of Commons of August, 1844, 558.

STROMNESS:

Hamilton, on the want of a harbour at Stromness, Oct., 1846, 628.

TARBERT:

For income in 1844-5-6, see p. 654.—Watt, on canal communication between Loch Gilp and Loch Crinan, and between East and West Locks, Tarbert, with estimates, &c., December, 1772, 629.—Belcher, on the proposed Argyll Canal, with estimates, &c., April 1847, 640.—Yule, on the proposed Argyll Canal, with estimates, &c., June, 1847, 647., Rep. xlvi.

TAY RIVER:

Surface of high water at Dundee is from 3 to 4½ inches below the level of high water at sea, *Leslie*, 195.—Mean depression between Broughty and Newburgh is 15 inches below the surface of the tidal water at its mouth, *Blackadder*, 223.—Great changes have taken place in its estuary, *ib.*, 222.—Description of the river given in Summary Report, pp. xxvi. xxvii.—(*See* also Dundee and Perth.)

THURSO:

Is formed by the outlet of the river, which falls into the sea at the south-east angle of Thurso Bay, Rep. xlii.—It has neither pier nor wharf, and is entirely in its natural state, *ib.*—The tide rises 13 feet on springs, when there is a depth of 15 feet over the bar, *ib.*—Westward of the outfall the depth increases to 14 feet, and a channel once dredged would probably, by the daily scour and land floods, clear the bar and keep it open, *ib.*—The arrivals in 1846 were 119 vessels of 5809 tons, *ib.*—(*See* Scrabster.)

Income and Expenditure:—

Income.—In 1841, 11*l.* 6*s.* 5*d.*; 1842, 13*l.* 19*s.*; 1843, 16*l.* 14*s.* 10*d.*, 375; for 1844-5-6, see p. 658.—The dues are levied by "use and wont;" there is no Act of Parliament, charter, or Commission, 378.—The dues are derived from 1*d* per ton for paulage on vessels entering the harbour, *ib.*

Expenditure.—In 1841, 18*l.* 12*s.* 3½*d.*; 1842, 28*l.* 5*s.*; 1843, 26*l.*, 375.

Miscellaneous Papers:—

Return to Order of House of Commons of August, 1844, 375.

TOBERMORY:

This one of the most useful harbours in the Highlands, easy of access, but rather too deep, there being from 18 to 25 fathoms, except close in shore, Rep. xliii.—The pier extends 100 yards from the shore, built in 1814 at a cost of 3,110*l.*, one-half being paid by the public, *ib.*—A second landing jetty was built in 1835 by the proprietor, *ib.*—The arrivals and sailings in 1846 were 425 loaded vessels of 29,783 tons, *ib.*

Income and Expenditure:—

Income.—In 1841, 14*l.* 2*s.* 1*d.*; 1842, 14*l.* 6*s.* 10*d.*, 1843, 11*l.* 4*s.* 3*d.*, 377; for 1844-5-6, see p. 656.—The dues are levied under the authority of an Act of Parliament, 377.

Expenditure.—In 1841, 11*l.* 5*s.* 6*d.*; 1842, 10*l.* 6*s.* 6*d.*; 1843, 10*l.* 5*s.* 6*d.*, 377.

Miscellaneous Papers:—

Lloyd's agent, on the necessity for extending the quay, 1846, 628.

TROON:

Present Condition of Harbour:—

An artificial tidal harbour, enclosed by piers, with an entrance 300 feet wide, with a depth of 11 feet at low water, and 19 feet at high water, at average spring tides, *Portland*, 539.—The piers are built of rubble-stone, faced with granite ashlar, *ib.*—The stones on the northern pier or breakwater vary from one to six tons in weight, *ib.*—There is a tidal basin with an area of 1¾ acres, and an average depth of 20 feet at low water, *ib.*—The extent of wharfage is 4664 feet, and water is laid down to the quays, *ib.*—There are three cranes, capable of lifting 10 tons each, and one of 2 tons, *ib.*—Evidence as to trade and seafaring population, *ib.*—There are six pilots, who charge 1*d.* per ton register above 45 tons, *ib.*—And one harbour light, *ib.*—A steam-dredge of 12-horse power, capable of lifting 200 tons of soil a-day, at a cost of 4½*d.* per ton, is in use, *ib.*—Evidence as to alteration in depth of water at the pier-head, and of the changes made in the last 50 years on the coast in gaining land from the sea, 539. Rep. lv.

Management:—

The harbour is the property of the Duke of Portland, who appoints a manager, 539.—The Charter of Queen Anne, granted in 1707, and the Act 48 Geo. III., the authorities under which the dues are collected.

Income and Expenditure:—

Income.—In 1841, 3591*l.* 4*s.* 5*d.*; 1842, 3447*l.* 7*s.* 2*d.*; 1843, 3014*l.* 5*s.* 8*d.*, *Maynard*, 539.—In 1845 the gross revenue amounted to 3992*l.*, 539; for 1844-5-6, see p. 656.

Expenditure.—In 1841, 6717*l.* 1*s.* 5*d.*; 1842, 5939*l.* 6*s.*; 1843, 4706*l.* 13*s.* 4*d.*, *Maynard*, 539.

Shipping and Tonnage:—

The arrivals in 1845 were, 1281 coasters of 98,712 tons, and 22 vessels of 5816 tons. In 1846 were 2436 vessels of 184,826 tons; of these 85 vessels of 21,597 tons were either foreign or colonial, Rep. lv.

Improvements Effected and in Progress:—

The basin has been deepened, by dredging, from a depth of 6 and 8 feet, to 11 feet at low water, 539.—In the last two years, 28,550*l.* have been expended in harbour improvements, *ib.*—250,000*l.* have been altogether laid out upon the harbour, *ib.*—The eastern breakwater has recently been extended 760 feet, *ib.*

Improvements Suggested:—

Lights.—A light on the Lady Isle would be very useful, 533.

WEST NEWBURGH:

Income and Expenditure:—

Income.—In 1841, 90*l.*; 1842, 86*l.*; 1843, 88*l.*, *Dickman*, 172; for 1844-5-6, see p. 658.

Expenditure.—In 1841, 49*l.*; 1842, 45*l.*; 1843, 48*l.*, *Dickman*, 172.

WEST WEMYS:

Is an acre and a quarter in extent, sheltered by a circular east pier with a sluicing basin at its upper end, Rep. xxiv.—Vessels of from 9 to 10 feet draft of water can lie afloat at low water, *ib.*—The shore dries 80 yards outside the pier head, *ib.*—There is a depth of 15 feet over the bar at spring tides, *ib.*—The arrivals in 1846 were 536 vessels of 38,610 tons. The revenue from dues levied by mutual consent amounted in the same year to 102*l.*, *ib.*

WHITEHILLS:

Income and Expenditure:—

Income.—In 1842, 32*l.* 4*s.* 9½*d.*; 1843, 34*l.* 9*s.* 11½*d.* 1844, 20*l.* 12*s.* 11½*d.*

Expenditure.—In 1842, 9*l.* 6*s.* 9*d.*; 1843, 6*l.* 18*s.*; 1844, 15*l.* 12*s.* 7*d.*, 336.

WHITHORN:

Description of the harbour, Rep. lviii.

Income and Expenditure:—

Income.—In 1841, 117*l.*; 1842, 119*l.*; 1843, 113*l.*, *Broadfoot*, 594; for 1844-5-6, see p. 654.—The dues are levied under a charter granted by James IV. to the corporation of the burgh, *ib.*

Expenditure.—In 1841, 14*l.* 10*s.*; 1842, 32*l.* 7*s.* 1*d.*; 1843, 68*l.* 12*s.* 5*d.*

WICK:

Present Condition of Harbour:—

The old harbour consists of the outlet of the water of Wick, the banks of which have been partially quayed, Rep. xl.—The channel is much filled up by sand and stones, *ib.*—The new harbours were designed by Telford, *ib.*—The inner harbour completed in 1811 at a cost of 16,000*l.*; the outer harbour in 1829, at a cost of 21,000*l.*, of which sum 7500*l.* was contributed by Government, and the residue by the British Fishery Society, *ib.*—Since its completion, the harbour has sanded up much. *Bremner*, 363.—The width of the outer harbour entrance is 80 feet, with 10 feet of depth at high water springs, and 7 feet on neaps, *ib.*—The whole area of the two harbours is about 12 acres, *ib.*—The great evil is the sand which comes from the river and the sea, *Bremner*, 363; *Cook*, 364; *Taylor*, *ib.*—South-easterly winds cause the greatest deposit of sand, *ib.*—Broadhaven is quite safe, *Stephens*, *ib.*—Even vessels of 100 tons have rode out a gale there, *Medley*, *ib.*—Vessels frequently cannot get into or out of the harbour from want of water, *Davidson*, *ib.*; *Taylor*, *ib.*—One drawing 12 feet, loaded, is lying near the harbour mouth, and cannot get out, *Davidson*, *ib.*—The cost of construction of the harbour was about 45,000*l.*, *Smith*, 371.—The arrivals and sailings in 1846 were 1081 vessels of 63,610 tons, Rep. xl.

Quays.—The quays and piers are of undressed whinstone and slate blocks. The eastern wall, with its parapet, is 30 feet high, and rises 20 feet above high water, *Bremner*, 363.—The extent of quayage is 2,500 feet, but much more is wanted during the fishing season, *ib.*—There are no cranes, but two are in progress of erection, *ib.*; *Taylor*, 364.—The area of the quays is two acres, *Bremner*, 363.—Fresh water is led in pipes to the quays for the supply of shipping, *Davidson*, 364.—The present harbour should be deepened, and stones placed under the foundation along the north quay, *ib.*

Dredging.—Large boulder stones lie at the entrance, *Davidson*, 364.—The sand in the harbour, instead of being cleared out by a steam-dredge, is only taken out by lighters and carts, *ib.*; *Taylor*, *ib.*—There is no steam-dredge, and one probably could not work while boulder stones are lying all over the bottom of the harbour, *Davidson*, *ib.*

Tides.—Spring tides rise 9 feet, neaps to 7 feet, above datum or low-water springs. They range about 5 feet, *Taylor*, 364.

Lights.—A light is to be erected at Noss Head, but Elzie Point, at the extreme east point, should have been lighted in preference, *Medley*, 365.—Noss Head was selected, as the light would be visible throughout Sinclair Bay, *ib.*—From Tarbert Ness to the Skerries there is no light along 60 miles of coast, and vessels are wrecked in Sinclair Bay from mistaking Noss Head for Duncansby Head, *ib.*—(*See* also Appendix, No. 284).

WICK—continued:

Present Condition of Harbour—continued:

Pilots and Pilotage.—There are 16 pilots, or two boats' crews belonging to the port, and their charge is 3*d.* per ton, *Taylor*, 364.—They pass no examination, and obtain licences on producing certificates of character from two shipowners and two shipmasters, *Taylor*, *ib.*—There should be a pilot cutter for vessels going through the Pentland Firth, as the rowing-boats are quite insufficient, *Medley*, 365; *D. Bremner*, *ib.*—The pilots should be examined, *ib.*—A decked pilot vessel could not be used, as there is no low-water harbour in which she could seek shelter in time of need, *Gunn*, 365.

Management:—

The present works of the harbour were commenced in 1807, and the old harbour completed in 1811, at the expense of the British Fisheries Society, for 16,000*l.*, *Bremner*, 363.—This harbour being too small and sanded up, an outer or south harbour was begun in 1824, and completed in 1829, for 21,000*l.*, paid by the same Society, *ib.*—The object of the south piers was to obtain a depth of 3 feet at the harbour mouth at low-water springs, *ib.*—A sailor's advice is not much followed in the harbour affairs, *Cook*, 364.—Sometimes the opinions of the Pulteney Town Improvement Commissioners, as to harbour affairs, are asked out of courtesy, but they have no voice in their management, *Crawford*, *Davidson*, &c., *ib.*—The bye-laws and tolls are painted on a board and exhibited on the quays, *Taylor*, 365.—There is a life-boat, with paddles, to be moved by a crew of 16 men, and a supply of rockets is kept ready, *ib.*

Income, Expenditure, and Debt:—

Income.—In 1841, 878*l.* 17*s.* 10*d.*; 1842, 902*l.* 12*s.* 11*d.*; 1843, 1069*l.* 12*s.* 9*d.*, *Smith*, 371.—In 1845, 1200*l.*, *Davidson*, 364; *Taylor*, *ib*; for 1844-5-6, see p. 658.—The dues are levied under the Act of 1814, and recently by order 7 and 8 Vic. c. 52, *Smith*, 371.—The dues are 2*d.* per ton on all vessels from 15 to 45 tons, and 4*d.* on all above 45 tons, *ib.*—Fishing-boats pay 8*s.* for the season, and goods 4*d.* per ton, *ib.*; *Taylor*, 364.—Herrings 1*s.* per barrel, *ib.*

Expenditure.—In 1841, 681*l.* 16*s.*; 1842, 1218*l.* 2*s.* 7*d.*; 1843, 1077*l.* 12*s.* 11*d.*, *Smith*, 371.—About 100*l.* a-year is usually expended in removing sand, and 500*l.* a-year in repairing the quays and roadways, *Davidson*, 364; *Taylor*, *ib.*

Debt.—5227*l.*, due on 1 January, 1846, *Smith*, 371.—31 December, 1846, 5828*l.* 4*s.* 8*d.*, Supp. 659.

Shipwrecks and Lesser Damage:—

There are numerous wrecks on this part of the coast, *Bremner*, 363.—In Aug., 1845, during a sudden north-west gale and heavy swell, 20 fishing boats and four lives were lost, *ib.*—In a distance of 20 miles 110 boats were wrecked, *ib.*—On one occasion 27 vessels, and many boats were lost, *Auld*, *ib.*—Vessels are liable to, and have suffered damage from, the stones at the mouth and in the bottom of the harbour, *Davidson*, 364; *Crawford*, *ib.*; *Henderson*, *&c.*, *ib.*; *Taylor*, *ib.*—Vessels were wrecked in Sinclair Bay, from mistaking Noss Head for Duncansby Head. The light to be placed at Noss Head will, it is hoped, remedy this evil, *Medley*, 365.—*See* also list of wrecks, 372.

Shipping and Tonnage:—

The annual arrivals and sailings of the port, including creeks between Freswick and Dunbeath (40 miles), are about 122 foreign, of 33,000 tons, and 664 coasting, of 35,000 tons, *Davidson*, 364.—2000 fishing boats are there during the season, employing 10,000 men as herring fishers, for about seven weeks, *ib.*—The value of the fisheries may be about 100,000*l.*, *ib.*—There are about 1818 tons of sailing vessels belonging to the port, *ib.*—There are no steamers, but one to and from Orkney calls weekly, *ib.*—200 seamen belong to the port, 600 fishermen, 100 coasters, and 50 boatmen, *Taylor*, *ib.* Rep. xl.

Improvements Effected and in Progress:—

The old harbour was completed in 1811 for 16,000*l.*;

WICK—continued:

Improvements Effected and in Progress—continued:—

the outer harbour, in 1829, for 21,000*l.*; both defrayed by the British Fisheries Society, *Bremner*, 363.—7500*l.* of this contributed by Government, and the residue by the Society, Rep. xl.

Improvements Suggested:—

More accommodation in quayage is wanted during the fishing season, *Bremner*, 363.—A low-water pier or harbour is especially needed, *ib.*—This pier should run out from the Salmon Rock 330 feet into the Bay, in a N.N.E. direction, giving 13 feet at the end at low-water springs, and costing 16,000*l.*, *ib.*—The space between might be converted into a harbour of eight acres (by continuing the present north wall in an E.S.E. direction, and excavating the rocks), with an average of 7 feet at low-water and 16 feet at high-water springs; the piers and walls to be on the upright principle, and the whole plan would cost 30,000*l.*, *ib.*—All the money should not be laid out at Pulteney Town, as a small sum might be expended at Broadhaven most advantageously, and berthage for 200 boats might be found there, *Medley*, 363-4: *Stephens*, 364.—The present harbour should be deepened and dredged, *Davidson*, *ib.*; *Commissioner*, *ib.*; *Crawford*, *ib.*; *Henderson*, *ib.*; *J. Bremner*, *ib.*; *Macpherson*, *ib.*; *J. Loutit*, *ib.*; *Taylor*, *ib.*—Stones should be placed under the foundations of the north quay, *Davidson*, *ib.*, Rep. xl.—A deep-water harbour is much wanted, *ib.*; *Crawford*, *ib.*—A wall should be carried round the road at the back of the north pier, and would cost 5,000*l.*, *Taylor*, *ib.*—A landing-place or low-water pier is wanted at Ackergill, *Medley*, 365.—There should be a pilot cutter for vessels going through the Rutland Firth, *ib.*—A light at Elzie Point in preference to Noss Head, *ib.*

Harbour of Refuge.—There is none between Orkney and Cromarty, *Bremner*, 363.—Such a building would cost 130,000*l.*, *ib.*—If erected, many shipwrecks would be prevented and lives preserved, *ib.*—Three-quarters of a mile of breakwater in 11 feet water at low springs, and 20 feet at high-water, would be requisite so as to get any shelter in the bay, *ib.*; *Auld*, *ib.*—No benefit could arise from the breakwater, as shipmasters uniformly stated that they would not risk making the coast of Caithness, even were a breakwater erected, *Medley*, *ib.*—The space inside would sand up, *ib.*

Complaints:—

Vessels in the harbour are liable to damage, and have suffered from the boulder stones at the bottom, *Davidson*, 364; *Crawford*, *ib.*—No exertion has been made to remove the stones from the harbour, *ib.*; *Henderson*, &c., *ib.*—That sand taken out of the harbour by lighters is thrown into the river at the back of the north pier, *ib.*—Want of a low-water harbour greatly felt, Rep. xl.

Reports of Engineers, &c.:—

Stevenson, on the proposed plan for improving the harbour of Pulteney Town, Wick, 1847, 370.—M'Pherson, on the state of the harbour, 1846, 371.

Miscellaneous Papers:—

Rhind's statement as to the harbour of Wick, 365.—Return relative to Acts of Parliament, Reports, &c., 1845, 366.—Extracts from Lieut. Medley's official correspondence respecting harbours, lights, pilots, &c., 1840-6, 367-369.—Return of income and expenditure for 1841-2, and 1843, *ib.*—List of wrecks in Sinclair's Bay, Caithness, 372.

WIGTOWN:

Description of the harbour, Rep. lviii.

Income and Expenditure:—

Income.—In 1841-2, 40*l.* 5*s.*; 1842-3, 43*l.* 10*s.*; 1843-4, 55*l.* 5*s.*, *Carron*, 596; for 1844-5-6, see p. 654.—The dues are levied under the authority of the magistrates and town-council, *Carron*, 596.—There is no Act of Parliament or charter relating to the harbour, *M'Haffie*, 596.

Expenditure.—In 1841-2, 7*l.* 5*s.* 1*d.*; 1842-3, 49*l.* 17*s.* 11*d.*; 1843-4, 20*l.* 11*s.* 4½*d.*, *Carron*, 596.

WOODHAVEN:

Income and Expenditure:—

Income.—In 1842, 2*l.* 17*s.* 7*d.*; 1843, 3*l.* 18*s.*; 1844, 11*l.* 18*s.* 5*d.*, *Stewart*, 171; for 1844-5-6, see p. 656.—The dues are levied under the authority of a charter, and immemorial usage, *Stewart*, 171.

Expenditure.—No account has been kept of the expenditure in the last three years, *Stewart*, 171.—Repairs on the pier and harbour are now required, which are estimated to cost 50*l.*, *ib.*

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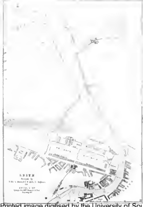
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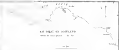
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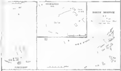
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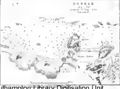
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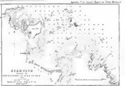
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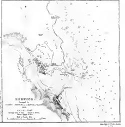
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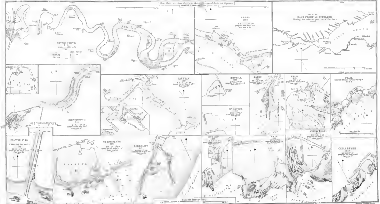
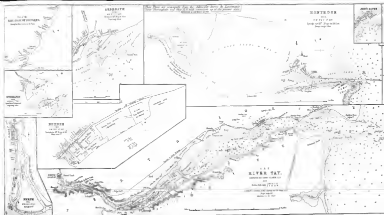
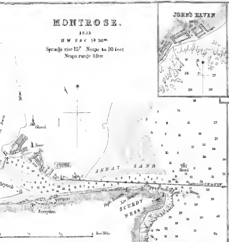

RIVER FORTH
ALLOA
Part of the EAST COAST OF SCOTLAND
FIRTH OF FORTH
GRANGEMOUTH
LEVEN
METHILL
LARGO
CRAIL
ST DAVIDS
GRANTON PIER
BURNTISLAND
KIRKCALDY
ELIE
ANSTRUTHER
CELLARDYKE
Scale for Harbour Plans



These Plans are principally from the Admiralty Survey by Lieutenants Slater, Sherringham and Otter R.N. with corrections up to the present date.



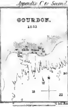
MONTROSE.

1833

H W F & C 1h 30m.

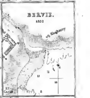
Springs rise 13ft Neaps to 10 feet

Neaps range 8 feet



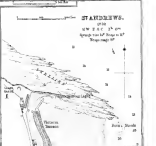
GOURDON.

1833



BERVIE.

1833



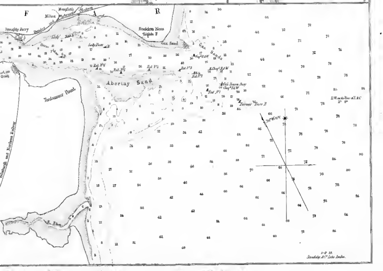
ST ANDREWS.

1832

H W F & C 2h 0m

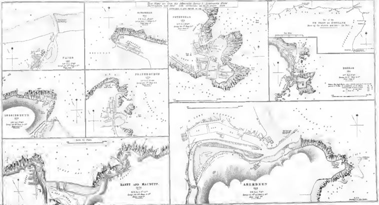
Springs rise 14ft Neaps to 11ft

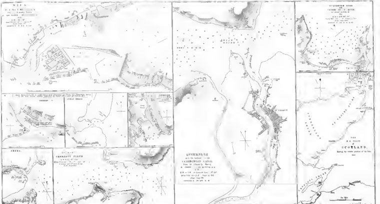
Neaps range 9ft

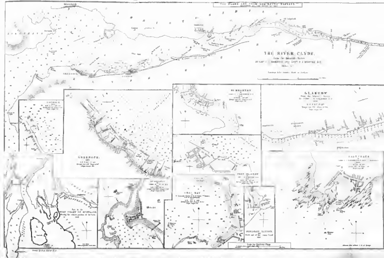


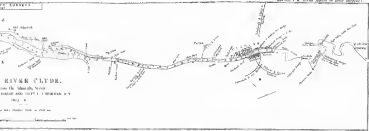
Standidge & Co. Litho London.

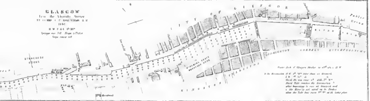
These Plans are from the Admiralty Survey & Scotchmake Hour Sherringham and Otter with corrections up to the present date

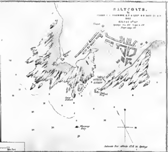


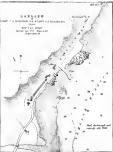

WICK
INVERNESS
and the Entrance to the
CALEDONIAN CANAL
CROMARTY FIRTH
THE
N.E. COAST
of
SCOTLAND,
Shewing the relative position of the Ports
SUTHERLAND SHIRE
CROMARTY SHIRE

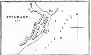

THE PLANS ARE FROM ADMIRALTY SURVEYS
THE RIVER CLYDE
GOUROCK
GREENOCK
DUMBARTON
GLASGOW
PORT GLASGOW
SALTCOATS
ARDROSSAN
Part of the WEST COAST OF SCOTLAND

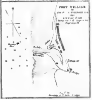

TY SURVEYS
RIVER CLYDE.
from the Admiralty Survey
1847
Old Kilpatrick
Partick
GLASGOW
Govan
Paisley Canal
Greenock & Ayr Railway
Pollock & Govan Railway
Edinburgh & Glasgow Railway
Rutherglen
Public Green

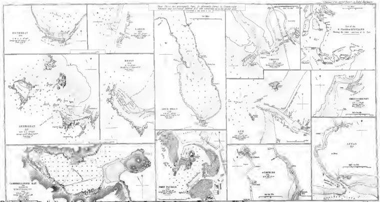

GLASGOW
from the Admiralty Survey
1846
CITY OF GLASGOW
Public Green
Broomielaw
Broad Clyde St
RIVER
KINGSTON
TRADESTON
GORBELS
HUTCHESONTOWN
Stobcross Docks


SALTCOATS.
1841
Chapel


LAMLASH
1844


INVERARY


PORT WILLIAM
1841


ROTHESAY
LARGS
LOCH RYAN
TROON
ARDROSSAN
AYR
ANNAN
CAMPBELLTOWN BAY and HARBOUR
PORT PATRICK
DUMFRIES

SECTIONS OF THE PRINCIPAL BREAKWATER PIERS ON THE COAST OF SCOTLAND